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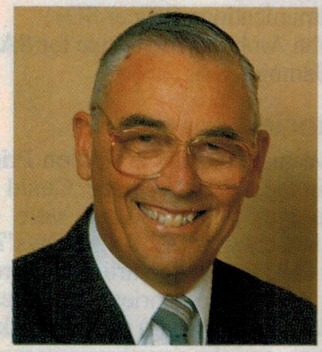
Volume 55, No.3

Electronics Australia with ETI

March 1993

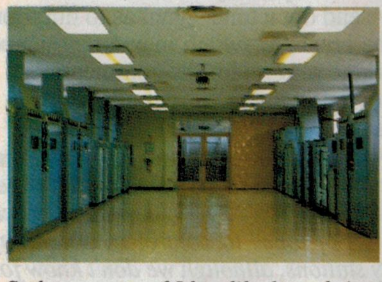
AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Success for local maker



Founded in 1959, Ted Dunn's Standard Communications has been steadily achieving an enviable reputation as an efficient local designer/manufacturer of radio communications equipment. Its latest UHF CB transceiver has met with great success (page 114).

VNG now on 2.5MHz...



Sydney users of Llandilo-based time and frequency standard station VNG can now receive it reliably, on 2.5MHz. Its transmissions now also feature a 'talking clock', as Arthur Cushen explains on page 48.

On the cover

Our main shot was taken inside Standard Components' modern factory in Gladesville, Sydney — although the set visible isn't their very latest GME Electrophone TX4000 UHF CB, but another recent product, the GX558. At upper left is shown our new 68705 development system (see page 74).

Video and Audio

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Projects and Technical

Professional Electronics

Columns and Comments

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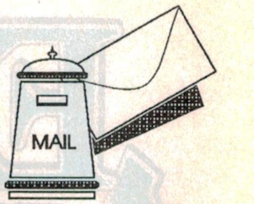
LETTERS TO THE EDITOR



Components for export

My company, with offices in Australia, Hong Kong and the People's Republic of China, is involved in the trade of electronic components. Each month, our office in China imports more than US$1 million worth of electronic components for the domestic China market, and for our own factory, 'Du Camp Successful Electronics Company'. We have the potential for considerable expansion. Currently, imports are of 'name brand' components, typically from USA, Japan, Taiwan and Europe.

Our Australian office has been opened recently. This prompts us to consider purchasing high quality electronic components from Australian manufacturers. However, locating these manufacturers has proved difficult. Despite approaches to government bodies like Austrade, we have not had much help in finding suitable manufacturers.

I am writing to enlist your assistance in this matter, because of your position in the electronics industry in Australia. If Australian manufacturers are truly capable of competing in the international market place, then our company is capable of providing an expanding export market for them.

Mike Smith,
Du Camp International,
PO Box 1211,
Milton, Qld. 4064

Comment: We've published your letter, Mike, so that firms will be able to respond.

Caller ID

With regard to the letter from Eric Lindsay in the October *EA* on Caller ID, he is incorrect in saying that business has the most to gain.

Emergency services (such as the Ambulance Service) have the most to gain, in that it enables them to rapidly and accurately locate a call for assistance, (particularly where the caller is difficult to understand) and reduce the number of false alarms.

The other principal issue in Caller ID is that of privacy. In both the USA and Australia there will be legislation covering this aspect, with access being restricted. The emergency services have a case in common law, based on the principle of 'preservation of life and property'.

The invasion of privacy is only to confirm whether assistance is required or not, to which in my experience the great majority of people have no objection.

R.J. Coonan,
Communications Officer SO1,
St John Ambulance Service for SA,
Mt Gambier, SA.

Memories

I have just read the article on Price's Radio in the December issue. Could you tell me was this the same store that traded in later years as 'Angel Toys'?

Also the construction article by Arthur Spring revived memories of my early work days (as in young) at A.W. Jackson Industries, and the construction/assembly of the Vernus organs.

The other reason for writing is in regard to the midnight to dawn programming on 2UE/2UW Sydney.

These programmes are relayed over a wide area of stations. Local station ID's and commercials are inserted into the programmes, although I take it the relays are not occupied by staff at the time. Do they send out a tone signal as to duration of the break, to switch in automatic tape cartridge players for the commercials?

Kevin Reynolds,
Padstow, NSW

Comment: We're not aware of any connection between Price's Radio and Angel Toys, Kevin. You're very likely right about the use of tones to control insertions by relay stations, although we don't know for certain.

Electric clock

When the first description of an electric clock came out, about 1944 I think, I made up my version and it worked very well for a number of years. Now I have decided to build the clock again, but things have changed since then and I find that I can buy a digital clock that will suit my cabinet and go for years without attention.

However I do have a heavy brass pendulum, which I want to use as an ornament — but this means using the trailing finger to pulse the magnet every 30 seconds or so. I wondered if there was a circuit available I could use to give the

magnet a boost automatically and so do away with the trailing finger which is a constant source of trouble. These days timers are used a lot, and I thought something may be available suitable for a clock. If a circuit is available please let me know, so that I can send a cheque to cover the cost.

To anyone interested I have a number of variable condensers (1, 2 and 3 gang) and also some old valves to give away.

J. Tait,
Pacific Palms, NSW

Comment: A timer won't be much good, Mr Tait, — you'll still need a system which senses the pendulum's position to give it a 'kick' at the right time. If you want to get away from the 'trailing finger' contact, an optical sensor would do the trick. We can't supply the exact circuit you need, but you should be able to adapt the 'Simple Light Switch' circuit given in the February 1992 issue. Reprints of the article are available from the Reader Services Department for $7.50.

Robot manual?

I really need your help. I'm a keen enthusiast of 'hobby' robotics, which is fairly scarce in Australia.

Back in November 1986, Dick Smith Electronics announced that they were selling 'Heathkit' kits. The Heathkit range, then, had three robots available called the 'Hero' range. Back then, DSE offered that the manuals of a kit could be purchased alone; but that was then.

The company no longer deals in Heathkit, so the manuals aren't available from them. Heathkit no longer produces these kits, so they couldn't help either (you'd think they would have one or two left).

Another company in Australia, 'Anitech' a division of the ANI Corporation also handled Heathkit back in 1986, but they seem to have disappeared without a trace and no one can tell me what has happened to them. So I'm running out of options.

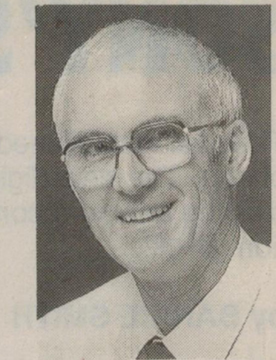
Perhaps one of your readers purchased one of the Hero range, or the manuals, back when they were available. Or perhaps you can offer some contact addresses where I may try to gain any or all of the manuals to the Hero range.

Any advice anyone can offer would be very much appreciated.

Chris Sergent,
Kempsey, NSW

Comment: Anitech is still in the Sydney directory, Chris. We don't know ourselves where you might be able to get a manual, but one of our readers will probably be able to help. If we hear from one, we'll let you know. ❖

EDITORIAL VIEWPOINT



Pay TV, HDTV and the viewing future

The as-yet largely unexplained loss of Optus Communications' B2 satellite seems to have added further to the uncertainty surrounding the future for officially sanctioned satellite-disseminated Pay TV in Australia. In fact things now seem to have stalled, not just because the Government seems to be deferring some of the politically difficult decisions, but now because Optus will need a further 18 months or so before it will have the necessary transponder capacity to cope with Pay TV in addition to its other services.

In one sense this delay doesn't seem to be such a bad thing, because it will give us more time for sorting out some of the remaining technical problems with regard to subscription and high-definition TV technology. It will also allow Australia to take more account of other developments overseas in this rapidly evolving area, and hopefully not make the mistakes of either sticking with obsolete technology, or leaping too fast into a 'new' technology that could possibly turn out to be a dead duck.

I'm thinking here of developments like the recent vote by the Telecommunications Council of the European Commission, which seems to have effectively killed any likelihood of Europe officially endorsing the D2-MAC system and using it as a path to HDTV. (The crucial vote was apparently cast by Britain, which seems ironic when you consider that the MAC system was developed there in the first place.) Also the very rapid progress being made with digital video transmission and compression technology, all around the world.

There is one complication that could well arise from the delay, however, and this is that the longer a decision regarding Australia's 'official' Pay TV system is deferred, the more it may become irrelevant. This is because the technology is rapidly providing a plethora of alternative distribution paths — optical cable, microwave carriers, digital 'burst' transmission over 'phone lines and so on. There's also a growing likelihood that programmes from the satellites of other countries and international organisations like Intelsat will be readily receivable in Australia, by anyone so inclined...

Whether you see this as a problem or an advantage depends on your point of view, of course. Those with a vested interest in either controlling what we're all permitted to watch, or making as much money as possible from our viewing, will presumably see it as a problem. They'd prefer a continuation of Australia's traditional tightly controlled setup, I'm sure. On the other hand those who are in favour of maximising viewer freedom of choice and access to information will no doubt see any such diversification and loosening of controls as a positive step forward.

One thing does seem likely. One way or another, we're probably going to get a considerably greater range of viewing choices in the next few years — whatever our Government does, or doesn't decide. It's going to be interesting, isn't it?

Jim Rowe

SONY'S NEW DIGITAL BETACAM

The well-established Betacam professional video recording format is about to enter the digital phase. The new digital Betacam VTRs (video tape recorders) provide backward compatibility with existing analog recordings, and also use a 'mild' form of video compression known as bit rate reduction (BRR).

by BARRIE SMITH

Video recording has come a long way — and has still a distance to go yet before producers and broadcasters, and their accountants, can lie calmly in their corporate bunkers. Over the decades we've seen 2" Quad, 1" helical scan, U-Matic 3/4", narrowing down more recently to the 1/2" Betacam and Betacam SP along with Panasonic's MII and 1/2" composite digital formats. These days we are also witnessing the increasing inroads being made by the 'pro' versions of consumer formats - - Video Hi8 and Super-VHS.

A muddle? Not really. In spite of valiant efforts by the MII proponents, Betacam SP still has market dominance globally — with an installed base of 150,000 units, both as field and studio camera and recorder units. In the studio, 1" is still common, while digital recording via computer hard drives and magneto- optical units is rapidly enveloping the task of mastering for manipulative post production.

Betacam SP gear is now bounced, shaken and thrown around in a variety of conditions, from equatorial climes to the Antarctic. The medium has found itself harnessed for the production of commercials, drama, news and documentaries, in many cases rising as a viable and qualitative alternative to 35mm and 16mm as a means of high quality origination. However while Betacam SP is a component format, it is still an analog format — and even when recorded immaculately, it can present limitations when multiple generations are required.

Topics that are inciting much interest and activity in the television circles of Europe, USA and Japan — although not this country, due to our Government's perpetual postponements — are the spectre of Pay-TV, improved domestic reception and HDTV standards choice.

Taking HDTV in isolation, the ferment continues about which HDTV system will conquer the globe. Producers and broadcasters in those regions still face the ridiculous prospect of 16mm, Super 16mm and 35mm film being the only common programme originating media which can span the global format jungle. A film camera/processor/telecine machine, as many of us will remember, was John Logie Baird's 'fall-back' in 1936, as a way of staving off the advance of electronic television!

Video standards

PAL will be with us for many years, as will NTSC and SECAM. As a transmission format, its technological future is very limited and recent developments in video signal handling have revealed several new methods of transmission offering delivery of improved vision and sound, with improved efficiency in terms of transmission power and spectrum economy.

As has happened in Europe with the PAL/SECAM duality, broadcasters now encode studio output into several transmission standards for delivery via terrestrial, satellite and cable methods. The common denominator to all this is component video, delivering advantages in picture processing and for conversion to other standards. However, analog component video — as in MII and Betacam — presents its own set of problems.

During the 1980's advances in digital signal processing made the digital component studio a practical proposition. The component D1 and composite D2 formats answered the requirements of high level, multiple-generation recording and, since 1986, machines in these formats have earned their living in top end post-production companies, where quality is paramount and cost a secondary consideration.

But, as we all know, the economic times have changed and operators have found that the cost of equipment ownership is a matter of greater importance than the quest for ultimate quality.

The worldwide trend, at all production levels, has been towards component

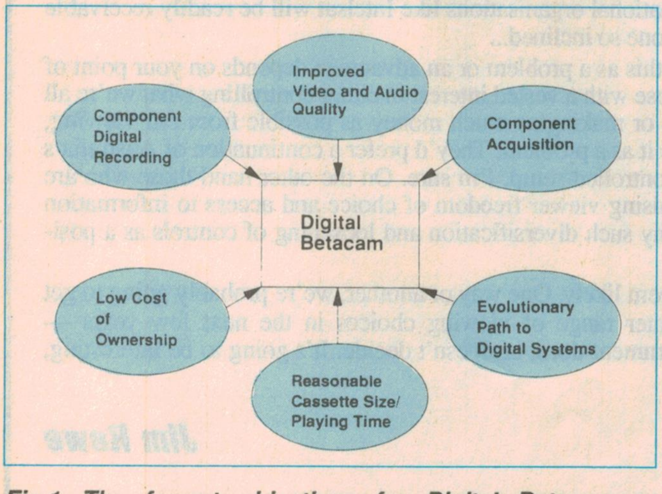


Fig.1: The format objectives for Digital Betacam, as defined by Sony.

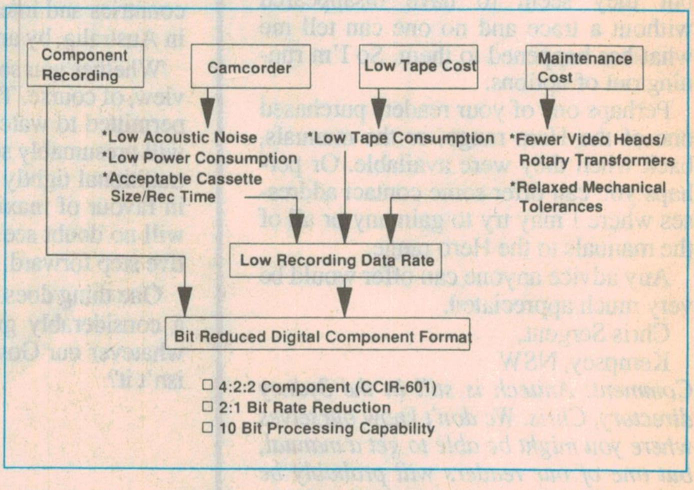


Fig.2: The reasons for using bit-rate reduction (BRR) in the Digital Betacam system.

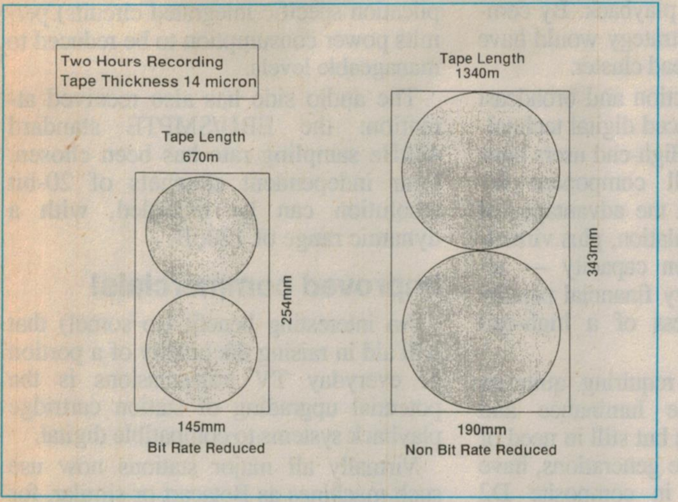


Fig.3: Comparative cassette sizes between Digital Betacam, using BRR, and a theoretical format which doesn't use bit rate reduction.

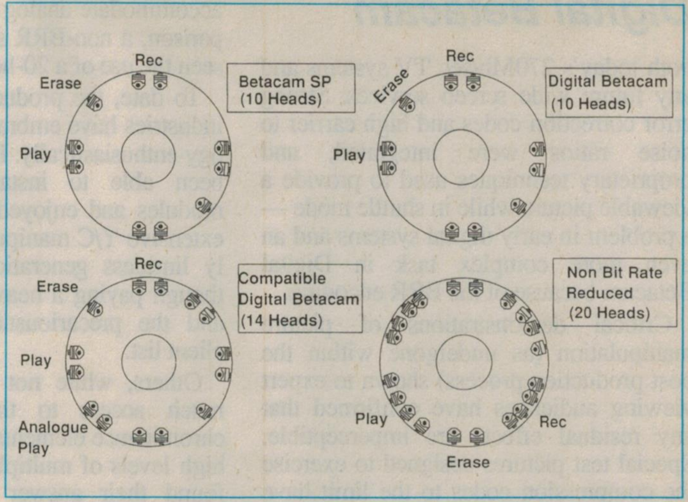


Fig.4: Head drum layouts compared for Betacam SP, Digital Betacam, Compatible Digital Betacam and a theoretical format not employing bit rate reduction.

Betacam SP, not only as an originating medium but as a post production format.

Reverse compatibility

There was obviously a need for a digital system, capable of loss-free multiple generations, yet with backwards compatibility to access vast libraries of Betacam and Betacam SP footage.

Sony announced its plans for a digital version of the format in 1991, and its intention to produce a range of Digital Betacam component recorders using 'bit rate reduction' (BRR) technology. The system was to be rolled out on March 1, 1993.

Digital Betacam provides full replay compatibility with existing conventional Betacam and its SP version — supplied via a specifically built VTR. In operation, the VTR automatically senses and selects the correct playback mode.

In setting up an edit suite, the operator is free to choose compatible or digital only units. Once the material is in digital format the attractive benefits of virtually loss-free multiple generation dubs naturally flows on.

BRR technology

The key to creating a digital format capable of going into the field in a wide variety of climatic conditions, yet still be able to function seamlessly in a fully-equipped studio environment, was digital signal compression.

The alternative to compression techniques was full bandwidth recording. But this path requires the capture of data at very rapid rates, as these examples show:

NTSC Composite Digital (D2 format, 8 bits): 144Mb/sec

PAL Composite Digital (D2 format, 8 bits): 177Mb/sec

13.5MHz Fs Component (D1 format, 8 bits): 216Mb/sec

13.5MHz Fs Component Digital Betacam (10 bit): 270Mb/sec

(Fs = sampling frequency)

To capture these data rates, a wider bandwidth would be obviously required. This may be achieved in a number of different ways:

1. Faster drum rotation speed: The standard Betacam head operates at 1500rpm, while the 1" format requires 5000rpm, D2 6000rpm and D1 9000rpm. In the latter case this, the operating frequency might be equated to 150Hz, but there is the additional noise of six heads hitting the tape per rotation. For six heads in D1 = 900Hz — a noticeable whine, which is not a problem in the studio but would require damping in a field unit.

A high drum speed would reveal other factors: the power drain is considerable with these high speeds, calling for increased battery weight; maintaining an existing track width would call for increased tape consumption; higher rotational speeds would also increase bearing load.

2. Longer track length: An increase in tape width would exceed hardware size constraints. Track length could be increased by using a shallower track angle, but this would call for a larger drum and heavier supporting deck.

3. Narrower track width: A narrower track would call for multiple heads, thereby increasing the noise factor, complexity, cost and mass.

4. Shorter wavelength on tape: A shorter signal wavelength would call for new tape/head technology or decreased margins in RF signal to noise ratio, along with an increase in dropouts (with increased error correction), mis-tracking and poor head/tape contact and less system robustness.

Compression of the signals is obviously a far better answer. Compression in computer signal processing is now an everyday matter, for even the humblest PC user. However, when a vision signal — along with its audio tracks — is due for reduction, the matter becomes more complex.

Compression rates of 2:1 are common in file compression. Sony have followed a similar level in Digital Betacam, where the reduction algorithm is applied within each video field and not between fields or frames. With this scheme no motion artefacts are possible; redundancy is achieved without loss of information.

Additionally, a reduction algorithm was chosen which ensures that the effects of the process would not accumulate over several generations — unlike analog processing where defects build up with increasing generations. In Sony lab tests 100 generations have been achieved with no noticeable degradation. This writer has viewed field tests of over 30 generations, and can attest to there being no visible loss.

The method of bit rate reduction used is DCT (Discrete Cosine Transform) — currently adopted by the EBU in point-to-point links at reduction rates approaching 10:1. Sony's 2:1 intra-field version is described as 'milder', and considered to be essential in the editing process where consecutive frames must match in quality.

In the Sony method, the picture is divided into blocks which are analysed under DCT and fed to a variable rate quantiser which enables a full 10-bit CCIR Recommendation-601 signal to be recorded. Adopting the world standard of CCIR-601 ensures compatibility with

Digital Betacam

both today's 270Mb/sec TV systems and any future wide screen services. Strong error correction codes and high carrier to noise ratios were integrated, and proprietary techniques used to provide a viewable picture while in shuttle mode — a problem in early digital systems and an even more complex task in Digital Betacam because of the BRR encoding.

Critical demonstrations of picture manipulation (as undergone within the post production process) shown to expert viewing audiences have confirmed that any residual effects are imperceptible. Special test pictures designed to exercise the compression codes to the limit have shown no more than any perceived noise increasing as a 'graceful degradation'.

Facing the situation of one BRR scheme undergoing a link with another different scheme, tests have shown any resultant artefacts have been imperceptible and solely due to the other system's 'less mild' methods.

Compatibility

Backwards compatibility is obviously an attractive element of the new format. Now existing Betacam and Betacam SP camcorders can 'live out' their natural lives, with their analog recordings able to be replayed on compatible Digital Betacam machines. Even more attractive is the potential for operationally mixing yesterday's analog machines with the 1993 digital models.

Not only is there no quality loss when playing an analog tape on a digital machine, the tape speed is also similar — thereby eliminating any potential mechanical problems with transports having to operate at different speeds.

Current Betacam machines use a 10-head drum. The new digital system will also use 10 heads. In a compatible machine four heads are added (total 14) to accommodate analog playback. By comparison, a non-BRR strategy would have seen the use of a 20-head cluster.

To date, the production and broadcast industries have embraced digital technology enthusiastically. High-end users have been able to install component D1 modules and enjoyed the advantages of extensive Y/C manipulation, plus virtually limitless generation capacity — although paying a heavy financial penalty and the precariousness of a high-end client list.

Others, while not requiring quite as much access to the luminance and chrominance elements but still in need of high levels of multiple generations, have found their answer in composite D2 equipment — and been able to balance the books better by existing in a less demanding client climate.

Digital Betacam now presents the best of both worlds — high level component quality in a digital signal, at a lower price.

Technical details

Current digital reorders use 8-bit resolution for video signals, due to the high data rates involved. The new standard CCIR-601/656 provides for 10-bit resolution for machine-parallel digital interfaces. Serial digital interface (SDI) also provide for 10-bit resolution, with a 270Mb/sec transfer rate.

Increased resolution gives more accurate reproduction, especially where scenes have subtle shading. Important also is the 6dB/bit lift in the S/N ratio. Digital Betacam will fully implement 10-bit recording, exceeding existing 8-bit systems. Its interface will be standardised to CCIR-601/656 or the 270Mb/sec SDI coaxial interface.

BRR has allowed the use of a slower head speed and reduction in the number of heads — a lowering of acoustic noise results. Pursuing this philosophy, combined with extensive use of ASICs (application specific integrated circuits) permits power consumption to be reduced to manageable levels.

The audio side has also received attention: the EBU/SMPTE standard 48kHz sampling rate has been chosen. Four independent channels of 20-bit resolution can be recorded, with a dynamic range of 120dB.

Improved commercials!

An interesting benefit (to some!) that will aid in raising the quality of a portion of everyday TV transmissions is the potential upgrading of station cartridge playback systems to compatible digital.

Virtually all major stations now use such machines as Betacart or similar, for day to day replay of short items in programming schedules. Now we'll be able to watch TV commercials and station promos in all the glory of their original vision and audio.

Winter Olympics

Norwegian host broadcaster NRK has chosen Digital Betacam for the 1994 Winter Olympics in and around the town of Lillehammer.

Over 20 hours of radio and TV coverage is expected to be generated each day of the games. The broadcasting centre will collect component digital source material via fibre optic links from 11 venues, providing 'feeds' to world-wide broadcasters.

A minimum equipment complement will include 40 analog Betacam SP VTRs and 75 Digital Betacam VTRs, along with an as-yet unstated number of digital field camcorders — all feeding to eight edit suites, TV studio and master control.

Digital Betacam was to be officially launched on March 1, 1993. The equipment complement will begin installation in Norway in August, 1993 and be ready for use in February of the following year. That's how fast digital is moving! ❖

	Play Heads	Rec/Rep Heads	Erase Heads	Total Heads	Rotary T'former
Betacam SP	4	4	2	10	8
Compatible DB'Cam	8	4	2	14	8
Digital Betacam	4	4	2	10	8
Non Bit Rate Reduced	8	8	2	20	16

Fig.5: The number of heads and rotary transformers required for the four formats shown in Fig.4.

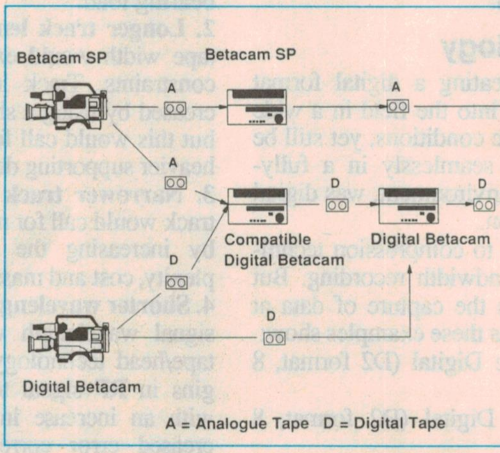


Fig.6: Digital Betacam and analog Betacam SP are backwards compatible, as shown here. This feature makes the new format particularly attractive to many broadcasters.

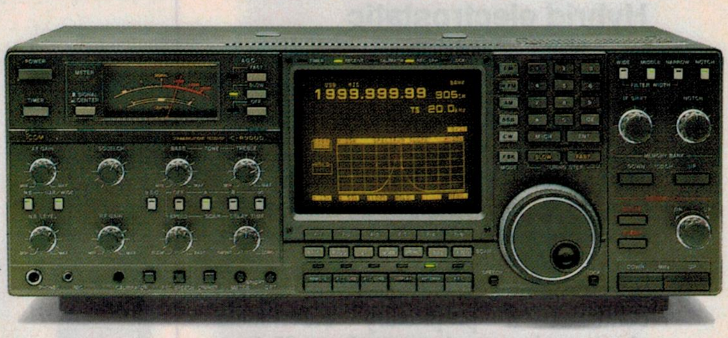
ICOM

Count on us!

Icom's impressive range of receivers lets you listen to more frequencies, across the band and around the world.

Starting with one of the smallest receivers ever produced, the IC-R1 covers 100kHz - 1300MHz (2 ~ 905MHz guaranteed), with AM, FM and Wide FM modes, Dual Frequency Selection and 100 memories.

The IC-R72 receives 30kHz - 30MHz (100 kHZ ~ 30 MHz guaranteed) in SSB, AM and CW modes and comes with numerous impressive features, including Icom's DDS System to improve Carrier to Noise Ratio characteristics and optional FM mode.



IC-R9000

With an Icom receiver, the world is as wide as your band

The mobile IC-R100 is packed with powerful features, and covers the 100kHz - 1800 MHz (500 kHz ~ 1800 MHz guaranteed) range in AM, FM, wide FM modes with multi-function scanning and 100 memories with 20 scan edge channels.

While the IC-R7100 covers from 25 ~ 2000 MHz in SSB, AM, FM, wide FM modes, optional TV and FM stereo adaptor, with 900 memory channels, sophisticated timer functions and multiple scan functions.

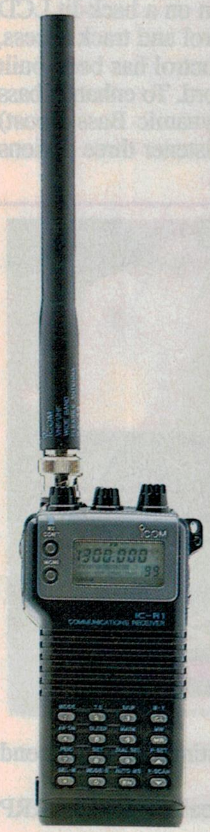
The top of the range IC-R9000 expands your listening horizons, covering 100 kHz ~ 1999.8 MHz in all modes and featuring Icom's unique CRT display, intelligent scan functions and an amazing 1000 memory channels, in a unit that delivers superb high frequency stability, even in the GHz range.

So tune in to the ones that professional listeners use, from the wide range of Icom wide band receivers.

IC-R7100

IC-R100

IC-R72



IC-R1

For further information call free on (008) 338 915 or write to Reply Paid 1009 Icom Australia Pty Ltd P. O. Box 1162 Windsor Victoria 3181 Telephone (03) 529 7582 A.C.N. 006 092 575

ICOM Australia's warranty is only applicable to products purchased from their authorised Australian Dealers.

L.L. BROWN ADVERTISING 3907

READER INFO NO. 2

What's New in VIDEO and AUDIO

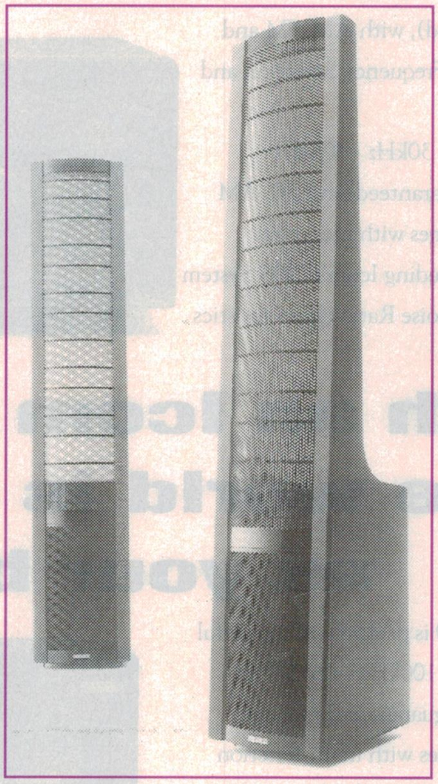
Hybrid electrostatic speaker system

The Martin Logan Aerius is the latest in the company's line up of hybrid electrostatic loudspeaker designs. Priced at $5995, the Aerius has been developed to provide an uncompromised yet affordable new reference standard loudspeaker. Evolving from over two years of cumulative technological advances, the system combines a proprietary curvilinear electrostatic transducer and an 8" bass woofer.

With a height of only 55", it uses a smaller electrostatic panel (38") and features 60% optical transparency of its electrostatic driver for lower visual impact. Another major benefit of the new model is its ability to be placed as close as one foot to surrounding walls.

The electrostatic thin film membrane is a 30° continuous arc that is claimed to offer a smooth and even dispersion with no 'hot spots'.

This film diaphragm is treated with a highly advanced conductive surface that has been vapour-deposited directly onto the polymer membrane in a vacuum environment. Being only 20 angstroms thick and having very low mass, the membrane is able to respond very rapidly to fast transients. The end result is a frequency response extended to over 20,000Hz.



Below 500Hz the 1.25 cubic foot bass unit takes over and is a loaded infinite baffle design that uses a forward-firing 8.5" driver with a response to below 40Hz. Able to be driven to high sound pressure levels (SPL), the Aerius system is capable of handling up to 200 watts RMS.

Philips previews portable DCC player

Displaying a sample at the Consumer Electronics Show in Las Vegas, Philips Consumer Electronics has announced that it will begin selling its first portable DCC player in this year's American summer.

The new personal headphone stereo DCC player, the DCC130, is claimed to be the first to offer music listeners CD-quality sound in a truly portable player. As with all players in the DCC family, the DCC130 will also play analog music cassettes from listeners' own collections.

The DCC130 will provide other digital features including direct track access and a scrolling text information display, with artist's name, album track title as well as time/track information on a back-lit LCD screen. For easy control and track access, a three key remote control has been built into the headphone cord. To enhance bass response, a DBB (Dynamic Bass Boost) circuit will give the listener three options for bass reproduction.

Colour video printer from Sony

The new Sony CVP-G700 Colour Video Printer enables the user to create a photographic print from a video recording in less than two minutes.

The CVP-G700 grabs selected images from the VCR or camcorder and, by reading input signals, scans the images in two stages (fields) which combine to make up a full frame. This image is then printed onto photographic paper.

Sony's Visual Products Manager, Ms Suzanne Hume, said: "Sony's leading-edge technology has vastly improved on the print picture quality produced by competitive colour video printers, enabling picture perfect results time after time". The CVP-G700 has adapted the same high quality LSI technology used in Sony's professional colour video printers for custom tuning of picture and colour.

The input signals are read in 256 gradations of the three primary colours (yellow, magenta and cyan), offering a range of nearly 17 million colour shades to produce a level of quality that is claimed to rival actual photographs.

The printer also features a full-frame digital memory which enables the user to make prints of high action scenes by memorising the first field of a frame and estimating the second field to capture 'life-in-action'.

The CVP-G700 is available from Sony dealers, with an RRP of $2699.

New car stereo amps from Kenwood

Kenwood Electronics Australia has announced two new stereo power amplifiers for cars. Designated the KAC-1023 and the KAC-923, the new flagship models offer 200 watts and 100 watts per channel respectively.

Both models employ Kenwood's 'Tri-Mode' operation, which enables the amplifiers to be configured for either bridged output, stereo output for normal use or Tri-Mode operation that allows the amplifier to drive one, two or three speakers.

The KAC-1023 features a dual mono construction with independent left and right heavy duty regulated power supplies, which employ low loss, power MOSFETs in push-pull parallel as high speed switching devices. Kenwood have included additional gold plated input/output connectors so other amplifiers can be connected to a multi-speaker system. For example, the KAC-1023 can be used to drive the sub-woofer while the KAC-923's drive the mid range and tweeter units.

Both the KAC-1023 and KAC-923 are designed to drive loads as low as 2-ohms, regardless of input voltage. Kenwood's proprietary Sigma Drive Connection extends the negative feedback loop, which is claimed to lower both output impedance and distortion. The input of both units uses a balanced and isolated design claimed to reduce input noise to immeasurable limits. Dual cooling fans and a three way relay protection system also ensures protection against excessive overdrive and heating.

Both models are covered by a 12-month parts and labour warranty. The KAC-1023 has an RRP of $1399 and the KAC-923 has an RRP of $699. Both models are available at selected Kenwood car hifi dealers.

The DCC130 also features an auto switch off, which means that the system automatically switches off four minutes after playback is finished and when no knob has been activated.

The DCC130 operates on two power sources, including an AC/DC adaptor and a rechargeable NiCad battery pack (one hour recharging time). This built-in battery pack allows the DCC130 to play for two hours. It comes complete with an optical digital output, patch cord and carrying case. The 0.5 kilogram personal stereo (including batteries) measures 120 x 35 x 118mm (WxHxD).

'Double Decker' goes side by side

Amstrad's controversial 'Double Decker' twin-deck video cassette recorder — which allows user to tape tapes and has been phenomenally successful since its release a year ago — has been 'flattened' with the release of a new, low profile version, the Amstrad DD9904.

The new Double Decker, made in Japan, takes advantage of the latest in VCR technology to literally halve in size. By designing an innovative 'side by side' loading system, Amstrad has managed to cram a twin-deck VCR into a unit no larger than a conventional single-deck machine.

Other claimed advances of the new Double Decker over its predecessor include:

'User Friendly' copying of tapes using a simple, one touch button (copying of tapes is subject to copyright restrictions);

- 'Quick start' for both short-play and long-play modes;
- Automatic tracking;
- Automatic head cleaning;
- A much simpler and easier-to-use infra-red remote control;
- Two SCART sockets; and
- Faster forward and reverse visual searches.

All of the features that made the original Amstrad Double Decker popular have been retained in the new model. The price remains unchanged at $999 RRP.

Marantz 'Special Edition' series

In its new Special Edition series, Marantz has produced a range of high quality components at budget prices, bringing audiophile sound within everyone's budget. The range encompasses the PM-80SE, PM-40SE and PM-30SE amplifiers and the CD-72SE and CD52SE CD players. Each of these players is based on the corresponding standard model (i.e., the PM-80, CD-72, etc), while incorporating special features for improved sound quality.

Marantz says that the Special Edition models present a 'bare bones' approach to the business of achieving the best possible sound. Each component has been stripped back to the bare essentials, but these essentials are of the finest quality. To this end, the SE amplifiers have no tone controls, and incorporate a 'Source Direct' switch which allows bypass of the balance and tape monitor controls. This means that only the volume control comes between the source and the power amplifier stage.

Behind the fascia, the original components have been customised, and the high-power amplifiers incorporate copper plated chassis and screws and toroidal power transformers. Likewise, the Special Edition CD-players include selected internal components, revised power supplies and analog filter stages, as well as superior components in critical stages.

All these improvements have been introduced without the large increase in price which one would expect considering the high quality components and the improvement in sound quality. ❖

Amateur Radio Review:

Icom's IC-2SRA and related handhelds - 1

Knowing his great interest in hand-held transceivers, we asked Lew Whitbourn to put the new Icom IC-2SRA transceiver/wideband scanner under his microscope. He discovered so many interesting similarities between this latest pocket-sized wonder and many of the other models in Icom's S-series and W-Series, that the review has turned into a two-part one, effectively covering the complete 'family' of handhelds...

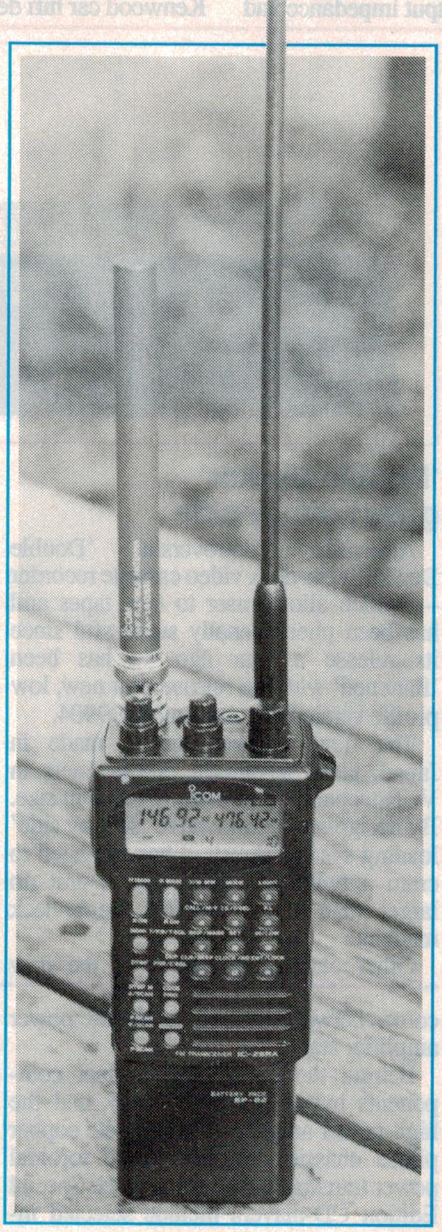
by LEW WHITBOURN, VK2ZIP

It seems to me that Icom is the most innovative manufacturer of VHF and UHF hand-held radios. The Icom IC-2SRA is a surprising new product which incorporates a VHF two-metre amateur transceiver covering 144 to 148MHz, plus a wideband scanner covering nominally 50 to 950MHz.

The most distinctive visual feature is the use of two top-mounted flexible whip antennas, as shown in Photo 1. The left antenna is a standard two-metre 'rubber duckie' about 12mm diameter and about 120mm long, mounted on the standard BNC bayonet connector. The right-hand scanner antenna is much slimmer and longer, about 6mm in diameter and 200mm long, and it is mounted on a 3.5mm phono plug. It is unusual to see such an audio connector used at frequencies up to 950MHz, but it works well enough.

It takes some time to get used to the looks of the IC-2SRA, with its two very different antennas and the right-hand scanner antenna sitting somewhat loosely in its audio connector. The two antennas are rarely parallel to each other, because of this loose fit. I would have preferred some sort of diplexer arrangement allowing simultaneous operation of the two-metre and scanner receivers from a single antenna, but of course separate antennas must give better performance.

The radio can be used for crossband operation, with transmit on two metres FM and receive on a number of other bands (10 metres, 6 metres or 70 centimetres) but, because of the lack of a diplexer, crossband duplex is not possible, which is no real loss in a battery-powered situation. The wideband



receiver automatically shuts down whenever the two-metre transmitter is activated.

The Icom genre

This is where I point out the similarities between a number of the current generation and recent Icom handheld radios. There is no doubt that Icom has the largest range of hand-held radios at any given time, usually offering technically superior features in a number of areas. But under the skin, the different Icom radios have a lot of similarities.

The IC-2SRA (as well as its 70cm UHF counterpart, the IC-4SRA) uses the same case as the Icom IC-W2A dual band 2m/70cm handheld transceiver and the new IC-X2 70cm/23cm dualbander, which has recently been released in Japan. The two bands in the IC-2SRA are labelled H (for Ham) and R (for Receiver), rather than V (for VHF) or U (for UHF) on the IC-W2A. While the 'Ham' label may be slightly unpalatable to many amateurs, it is clearly more convenient for Icom, because it allows the same keyboard and screen labels to be used for both the IC-2SRA and the IC-4SRA. So H stands for V or U, depending on which model it is!

The programming of the IC-2SRA is virtually identical to that of the IC-W2A, with the scanner being treated much like the second transceiver of the dual bander. The biggest difference is the number of memory channels, which is 33 (30 standard + 2 scan edges + 1 call channel) for each band in the IC-W2. The IC-2SRA has 33 memories for its two-metre transceiver and 63 for the scanner.

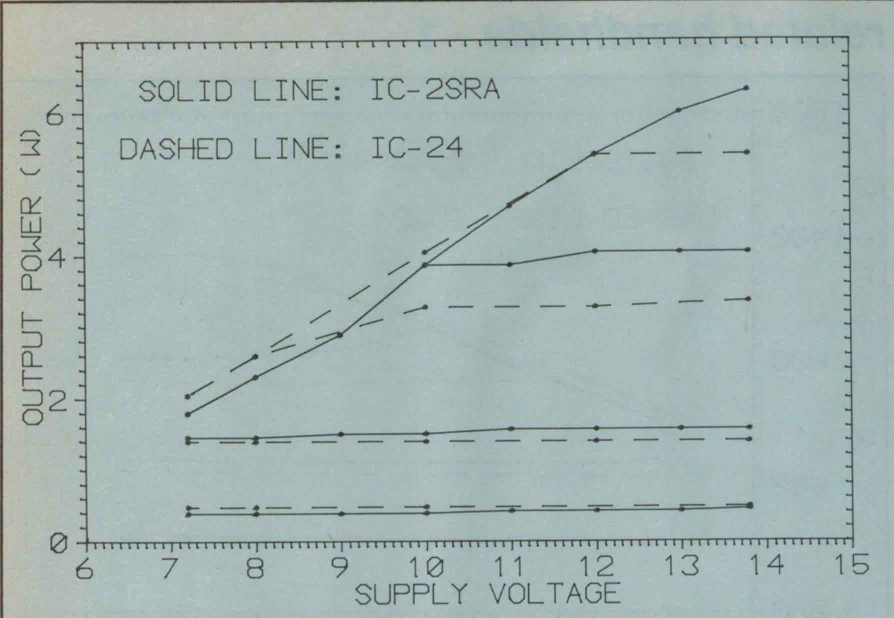


FIG. 1 IC-2SRA POWER VERSUS SUPPLY VOLTAGE

The extra memories for the receiver probably result from not having to store separate transmitter offset frequencies for each receive frequency.

It is interesting to look at circuit similarities as well. The VHF receiver (including IF), transmitter and synthesiser circuits of the IC-2SRA are all virtually identical to those of the VHF half of the IC-W2A.

I first became aware of this Icom circuit recycling phenomenon recently, when I discovered that the VHF circuits of the IC-24AT dual-band handheld were the same as those of the IC-2SA and IC-2SAT two-metre transceivers, while its UHF circuits were the same as those of the IC-4SA and IC-4SAT 70cm transceivers.

On the basis of the similarities described above, I suspect that the wideband receiver part of the IC-2SRA/4SRA is very similar to that of the tiny IC-R1 wideband receiver, which appeared about two years ago. I do not have a circuit diagram of the latter, but I do know that the IC-R1 has the same first IF frequency of 266.7MHz, which is pretty distinctive, and I have measured very similar current drain from the IC-R1 and the broad band receiver of the IC-2SRA.

The IC-2SRA/4SRA and the IC-W2A are described by Icom as the 'W-series' while the earlier radios mentioned above are all the 'S-series'. All use the same battery packs, external powering circuits and charging arrangements, although with a different charging plug which is discussed below. The later radios, the IC-24AT, W2A and 2SRA/4SRA are all wider than their battery packs, which were originally designed for the original S-series, the IC-2SA(T)/4SA(T). A consequence of this is that the IC-2SRA/4SRA and the IC-W2A look a little strange sitting off-centre on narrower battery backs, as can be seen in Photo 1. Another consequence is that the higher capacity backs are very long; somewhat longer than they would have to be if they matched the radios in width.

IC-2SRA programming

I found the radio quite easy to program. The (Icom-generic) function (F) key on the top right-hand side enables second functions for most of the keys on the front panel. Programming is quite similar to that for earlier Icom radios, and I found that I could get most basic functions going with minimal reference to the handbook — which at 60 pages long is very comprehensive. The slightly unusual arrangement of the keys leaves a space on the bottom right of the front panel for the small internal speaker but also turns out to be quite ergonomic, with commonly used keys (e.g. enter, up, down, clear etc.,) easy to find in distinctive places around the edges, even in the dark.

The radio has good display lighting, which can be programmed for either momentary or indefinite operation, but the keys are not illuminated like those of the new Icom P-series, which, however, does not yet offer multifunction radios like the IC-2SRA/4SRA and IC-W2A.

Two large keys on the top left of the keyboard, labelled H MAIN and R MAIN are used to select the band that is currently subject to keyboard control — as indicated by the label MAIN in either the left (Ham) or right (Receiver) window of the LCD display. Subsequent keystrokes then operate on that band only. Using the function key to select a band as MAIN turns the other band off, which saves power. Grey and blue coloured labels next to the keys show the primary and secondary (i.e., 'F' +) functions of the keys.

The IC-2SRA even has independent SET modes for the two bands. These modes allow setup of tone frequency scan skip/resume status, battery saver cycle, repeater offset (HAM band only) and the most significant digit for keyboard entry (receiver only in the Australian version). The Ham band SET mode has a few other extras, such as the auto power-off function, which can be set to off/30 min/60 min, a clock, a power-on timer and four 15-digit DTMF memories.

The radio is equipped as standard with a three-digit DTMF code squelch function, which operates independently for both receivers. Each receiver has a three-digit ID memory and five other three-digit memories which can be set for 'receive accept' or 'receive inhibit'. Both code squelch and paging (i.e., beep on receipt of correct code) are possible. Of course paging can only be initiated from the Ham band.

A red key at the bottom of the keypad is a 'soft' power on/off key. One advantage of a separate power switch is that it does not change the volume control setting. A disadvantage is that you cannot turn the radio off after battery discharge proceeds beyond a certain critical voltage. I found that I could get around this by disconnecting the battery, letting it recover under no load for 10 or 20 seconds, then reconnecting the battery and shutting off in rapid succession! This is the only way to avoid thoroughly flattening a discharged battery, other than permanently disconnecting it.

The standard battery supplied with the IC-2SRA is the 7.2V (six cell) 300mAh BP-82, which is only 40mm long. Overall dimensions of the radio with this pack are 54mm wide x 135mm high x 36mm deep, although the transverse dimensions of the battery pack are somewhat less at 49mm wide x 33mm deep, as mentioned earlier.

With the BP-82 the IC-2SRA is quite small, more or less shirt pocket sized, but not all that convenient with the receiver whip connected. However the BP-82 does not last very long as the cur-

rent drain of the receiver alone is about 100mA when scanning, so a larger capacity battery would be necessary for serious use.

The drop test

I have seen other radio reviewers fantasise about doing a drop test on some of the radios that they review. I didn't have very long to review the IC-2SRA, and the period included my Easter holiday in the country. I don't normally like taking review radios outside a padded room (come to think of it, they don't let me out all that often!) but this time I had no choice.

An incident in the outdoors with the IC-2SRA in my shirt pocket and an over-exuberant dog saw the radio fall onto a rough concrete path, naturally missing the lawn by centimetres (Mr Murphy had apparently come with me). It made a horrible (non-electronic) noise and scratched the BP-82 pack rather badly, but the radio didn't miss a beat. It just kept scanning.

Subsequent testing revealed no change in transmitter performance or receiver sensitivity, but it didn't make me feel a whole lot better about the incident. Icom's General Manager Bob Wiley was very understanding about the whole thing — I guess the real test will be how long it takes before I get another Icom radio to review!

The main point to make here though is that the Icoms are as tough as they look — they are certainly 'commercial quality' in the physical sense.

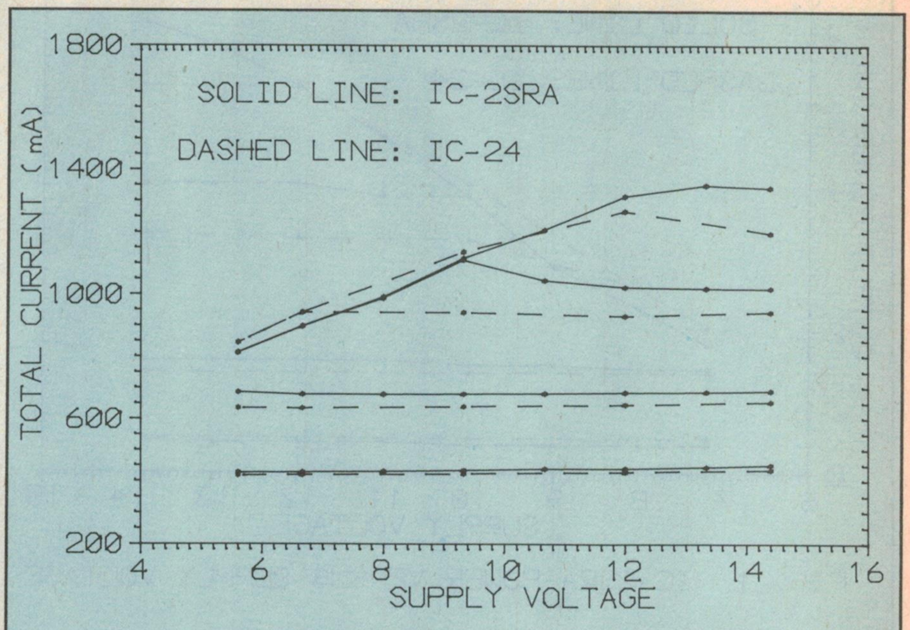


FIG. 2 IC-2SRA CURRENT VERSUS SUPPLY VOLTS

Two-metre transceiver

As expected the two-metre transceiver part of the radio worked in the normal superb Icom fashion, with transmit and receive performance slightly better than that of the IC-24 that I tested a while ago.

Despite having a virtually identical receiver, the IC-2SRA showed better sensitivity, at 0.12uV (instead of 0.17uV) for 12dB of quieting throughout the 144-148MHz two-meter amateur band. The two-metre receiver has a first IF frequency of 30.85MHz and uses low-side local oscillator injection, with the 80MHz image response down by about 65dB.

I put the difference in sensitivity down to the fact that the IC-2SRA does not have band switching circuitry between the antenna and receiver front end; but it could be something else. Although it has the same three-stage varicap track-tuning as the IC-24AT, IC-W2A and IC-2SA(T), the IC-2SRA does not have the wide receiver tuning of these other radios, which generally cover from about 108 to 174MHz, with AM detection below 138MHz.

Presumably Icom decided that the wideband scanner in the same package makes this unnecessary. I don't really agree, for reasons that I give later, and I note that the 2SRA's destined for the US market do have 138 to 174MHz coverage.

With earlier Icom radios, the difference would only be one or two diodes connected to the CPU chip, but Icom has been making noises lately about using different mask programs for different models — so it may not be possible to modify the Australian model for the extended coverage. On the other hand, the circuit diagram shows a standard Icom-type diode matrix connected to the MAIN-band CPU chip (there is a second CPU for SUB band), so I suspect it still may be possible.

Performance of the IC-2SRA transmitter section is very similar to that of the

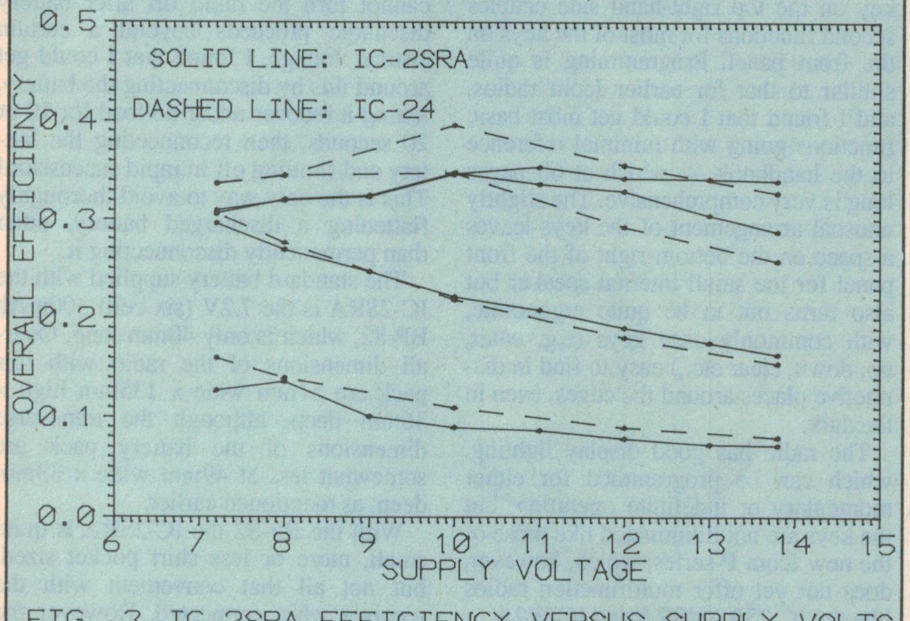


FIG. 3 IC-2SRA EFFICIENCY VERSUS SUPPLY VOLTS

IC-24AT/2SA/2SAT, but with slightly improved performance (i.e., power and efficiency) at higher supply voltages. The difference seems to be that the IC-2SRA, like the IC-W2A, uses a newer power amplifier output chip (2SC1142 instead of 2SC1096).

Fig.1 shows output power as a function of supply voltage for both the IC-2SRA and an IC-24, showing less saturation of power at high voltages on the high power setting (top curves) and slightly greater power on the three low-power settings — which are designated Low 3, Low 2 and Low 1 in decreasing order. Figs.2 and 3 show the variation with supply voltage of current drain and overall efficiency associated with the four power settings.

Like output power, the supply current is slightly higher with the IC-2SRA, with the result that efficiency is about the same as that of the earlier S-series radios. The important difference is that the IC-2SRA has better power and efficiency at higher supply voltages, at the expense (to a small extent) of power and efficiency at the low voltages.

I have always thought that there was no point in powering any of the current generation of Icom handhelds with voltages as high as 13.8V, and the curves shown in Figs.1-3 show why. This may be less so with the IC-2SRA (and IC-W2A) than with the others, but Icom seem to have decided the same thing because the external power socket is now labelled 12.5V (instead of 13.8V as on the earlier radios).

Reports on transmitted audio from the IC-2SRA using its internal microphone were always excellent, while received audio quality was surprisingly good from a speaker which cannot be much more than 25mm in diameter.

Incidentally, the quality of the wideband FM of the scanner through this speaker was even better — remarkably good in fact. So any limitations in audio quality on the two-metre band are much more to do with the compromises of a communications quality receiver than the size or quality of the loudspeaker.

I was not able to test external speaker-microphone operation, because the W-series now uses a stereo 3.5mm phono socket for the external speaker-microphone, so my old accessories using a 3.5mm/2.5mm pair of plugs will not work with these newer radios. Icom list two new speaker microphones for use with the IC-2SRA, the HM-65 and the HM-70, and a headset, HS-60, which includes PTT and 'one-touch' PTT.

(To be continued) ❖

The early history of Australia's Radar - 3

In this last of his articles discussing the development of Australian radar systems during World War 2, the author describes the attempts to develop height finding and ground-controlled interception (GCI) radars. He also provides a summary of what had been achieved overall by the end of the war, and concludes with a selected bibliography for those wishing to explore the subject further.

by COLIN MACKINNON, VK2DYM

Up to this point, all the radars described had relied on estimating aircraft height using charts of the vertical antenna beam pattern. As mentioned previously, some operators became expert at estimating aircraft heights, but variations in antenna side lobes, local site situations and signal fading made height finding very unreliable. Consequently our fighters were often sent out too high or too low to intercept the enemy aircraft.

In addition, the RAAF had a need for the Plan Position Indicator or 'PPI' type of radar display, which gives a map-like representation of the radar picture around a station and allows fighter aircraft to be more easily guided towards the targets.

The German scientists had an operational height finding radar code-named 'Wassermann', and RPL built their own much smaller version in late 1943 using a 12.5m-high square lattice mast to which was fitted the four sections of an LW/AW antenna, for a total of 32 elements — but now placed one above the other (see Fig.19).

The idea was to electrically switch the phasing of the array segments, to swing the beam lobes up and down in order to achieve a height display on the CRO tube, as well as a distance display. This monster towered above the cliffs of Dover Heights for a time, but the RPL discovered that the vertical beam width of this antenna was so narrow as to be unusable.

In early 1944, the RPL worked to adapt a Canadian set by fitting it with a new antenna on a MkII hut — to become the LW/GCI MkI, where 'GCI' stands for Ground Controlled Interception. The radar equipment used was the UK-designed 'LW' set (meaning of course 'Light Weight') which was being manufactured in Canada and supplied to US and allied forces as the SCR-602-T6.

In its original form, the SCR-602-T6 comprised a push-pull transmitter using two NT99 micropup tubes, giving 100kW output on 212MHz with an updated design of ASV receiver. The antenna was an array of four six-element Yagis (2 x 2), connected by 140Ω co-axial cable so that the top two could be switched in or out of phase with the lower two, to alter the vertical beam pattern and provide an elementary form of height finding (see Fig.20). The equipment had a 230mm (9") PPI-display CRT and a 125mm (5") range CRT.

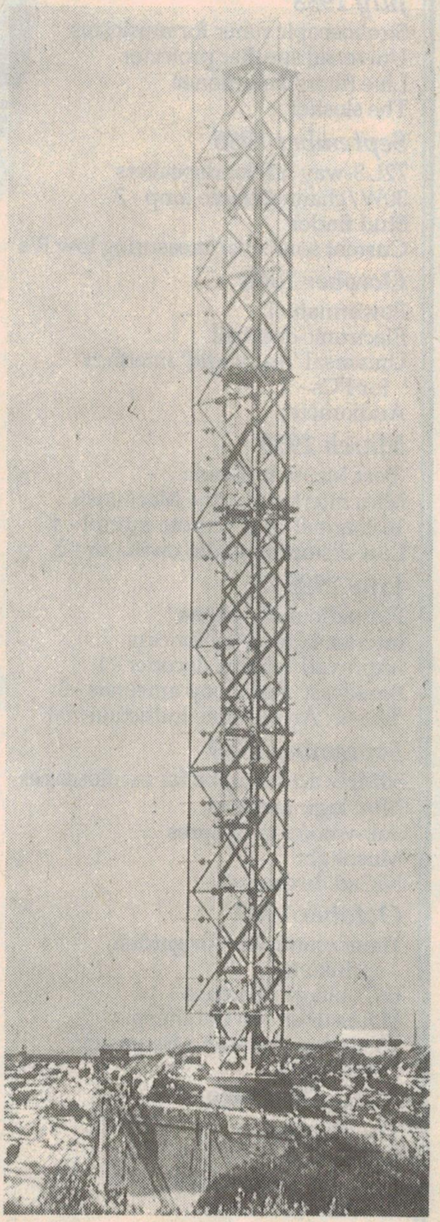


Fig.19: In late 1943, RPL built a height finding radar at Dover Heights in Sydney, modelled on a German design.

The RPL retained the phasing switch to obtain 'heighting', but their antenna consisted of two phased arrays each of 16 elements (two rows of four fat horizontal dipoles), one above the other at heights of 4m and 6.6m respectively (Fig.21).

Four sets were supplied to the RAAF and another 20 went to the US forces in the Pacific, but they were not entirely satisfactory because the antenna patterns did not cover the range/height envelope required. It had a maximum range of less than 80km and up to 70km at 35,000 feet, but only about 10km at 10,000 feet with gaps in the coverage.

In addition the SCR-602-T6 was notoriously unreliable, and was not originally tropic proofed. In fact they were so bad that two complete sets of equipment were supplied to each station to try to maintain operations. The output power and range claimed for the SCR-602-T6 by the US and Canadian manufacturers was highly suspect.

Whilst the complete electronic setup was quite complex, it did have the advantage of breaking down into manageable units which could be manhandled and transported readily. The Ford 10 engine/generator was used with two 80-volt 1200Hz alternators, bolted on and driven by extra V-belts to provide power for the US set. One of the LW/GCI MkI's was sited near Essendon airport, Melbourne, for a few weeks in 1945 to evaluate it for civil air traffic control.

Fig.20: A Canadian made SCR-602-T6, ground controlled interception (GCI) radar, based on the UK designed LW radar set. It operated on 212MHz.

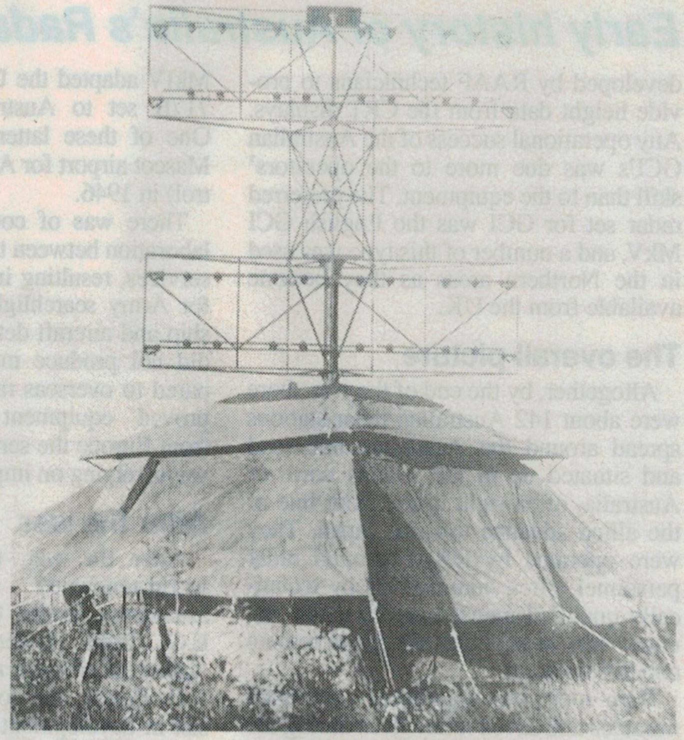


Fig.21: RPL adapted the SCR-602-T6 GCI radar by providing it with a new antenna mounted on a MkII hut. This became the LW/GCI MkI radar of early 1944.

As a result of the less-than-successful LW/GCI MkI, RPL designed the LW/GCI MkII, which had *three* arrays at heights of 2m, 4m and 6m. Each array was of two rows of six dipoles (i.e., 72 elements in total). This complex arrangement was power rotated and the operators sat in a clip-together plywood hut mounted at the rear of the array mast. For stability the turntable was supported on five tubular frame arms, radiating out like a star on the ground (see Fig.22).

The electronics were still based on the SCR-602-T6, but modified by RPL to improve the reliability. Six sets were supplied to the RAAF at the end of 1944, but they were only marginally more successful than the LW/GCI MkI because of the horrific problems of controlling the vertical beam pattern.

Various charts and plotting scales were

Fig.22: NSW Railways staff assembling the clip-together plywood cabin of an LW/GCI MkII radar. The Ford 10 generator set is visible at lower left.

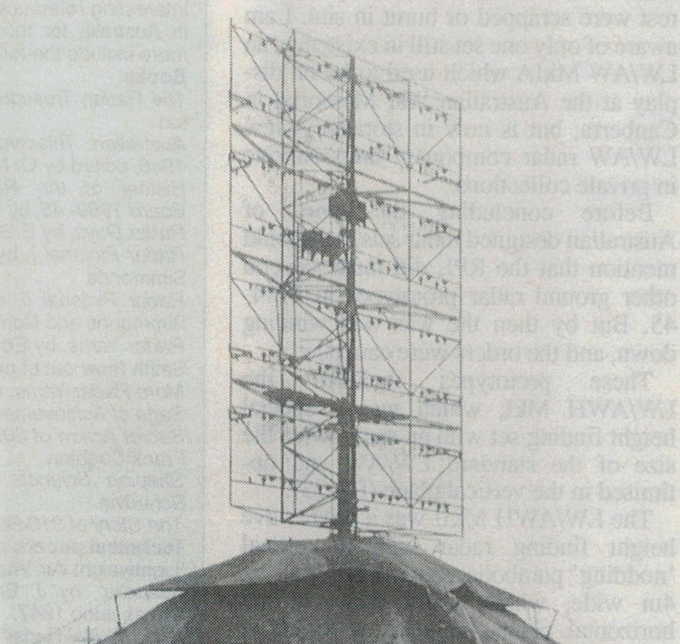


Fig.23: A general view of the LW/AWH MkI height-finding radar developed at the end of the war. Wind loading of the antenna created severe stability problems.

Early history of Australia's Radar - 3

developed by RAAF technicians to provide height data from the CRT displays. Any operational success of the Australian GCI's was due more to the operators' skill than to the equipment. The preferred radar set for GCI was the English GCI MkV, and a number of this type was used in the Northern areas as they became available from the UK.

The overall picture

Altogether, by the end of the war, there were about 142 Australian radar stations spread around the Australian mainland and situated up in the islands north of Australia, often right in the front line of the allied advance towards Japan. They were operated by RAAF ground radar personnel, often commanded by technically qualified men barely 20 years old, under very arduous conditions in remote and hostile areas.

Both men and equipment performed miracles and saved many lives during the war. Only now are their exploits being recognised, along with the technical contributions of our scientists, technicians and manufacturers — which rank just as highly as the much-publicised UK and US achievements.

After the war, several of the LW/AW transmitters were modified and used in the new DME (Distance Measuring Equipment) system developed by CSIR and the Civil Aviation Authority. But the rest were scrapped or burnt in situ. I am aware of only one set still in existence, an LW/AW MkIA which used to be on display at the Australian War Memorial in Canberra, but is now in storage. A few LW/AW radar component units survive in private collections.

Before concluding the story of Australian designed radar sets, we should mention that the RPL did make several other ground radar prototypes in 1944-45. But by then the war was winding down, and the orders were cancelled.

These prototypes included the LW/AWH MkI, which was a special height finding set with an array twice the size of the standard LW/AW and optimised in the vertical plane (Fig.23).

The LW/AWH MkII was a microwave height finding radar with a vertical 'nodding' parabolic antenna 8m high by 4m wide, which could rotate in the horizontal plane. On trial at Bondi in August 1945, it exhibited dangerous self-destructive instability problems and was eventually scrapped.

The LW/GCI MkIII was a microwave set using an Australian manufactured magnetron, and then the LW/GCI MkIV adapted the US microwave SCR-717B set to Australian specifications. One of these latter sets was tested at Mascot airport for ATC (Air Traffic Control) in 1946.

There was of course significant collaboration between the RPL and the other services, resulting in radar sets designed for Army searchlight control and Navy ship and aircraft detection. These efforts did not produce marked benefits compared to overseas radars, and as the improved equipment became available from Europe the services went their own ways, relying on imported sets.

After the war

After the war, the RPL became a world-renowned centre for radio astronomy, under the guidance of Dr E.G. 'Taffy' Bowen, the acknowledged 'father' of airborne radar.

Dr Bowen had gone to the USA to assist in development of their radar effort, and when that was well under control he transferred to the RPL in 1943 and in 1946 became head of the Division. He was instrumental in the funding and construction of the Parkes Radio Telescope, and later on became chairman of the Anglo-Australian Telescope Board.

Many of the RPL staff stayed on and formed the nucleus of the radio astronomy research centre, whilst others returned to civilian life, sometimes in fields totally unrelated to the vital work they had performed during the war.

Although this article has concentrated on the Australian-made ground radar sets, it should be mentioned that a number of imported ground radar types were used in Australia during the war. These included the US-made SCR-268 and SCR-270 and the BL4 Interrogator, and the UK-made ACO, CD/CHL, CHL, COL, GCI MkV and the Canadian RWG/GCI.

The SCR-268 is of particular interest. It was the first production US radar and was intended for army gun laying. A number were shipped to the Phillipines, but diverted to Australia upon the fall of that country to Japanese forces. We had no real need for another gun-laying radar, so RAAF and RPL technicians altered the circuits so that it had a long range Air Warning role. It was then known as the MAWD, for Modified Air Warning Device, and eight of this type were operated by both Australian and US personnel.

The US forces in Australia also operated several long range Air Warning SCR-270's (the same type that warned of the impending attack on Pearl Harbour).

This story has highlighted the technical side of Australian radar, but there are many other facets to the whole story. There were severe shortages of supplies and long delays, and the RPL was accused of poor planning and bad management. There was in fact some acrimony between all sides, but luckily the problems were overcome by various means and the production of radar sets settled into an effective routine.

The services, particularly the RAAF, had technicians and engineers working closely with RPL scientists and they made many radar innovations in their own right.

For the human side of RAAF operation of ground radar, the newly released books *Radar Yarns* and *More Radar Yarns are recommended, while Radar Pictorials I and II* provide rare and historic photos of Australian radar stations.

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HURRY OFFER ENDS 24th MARCH 1993

Wide Screen Movies: New Technology, Old Gear!

The 1950's were something of a golden era in the New Zealand cinema scene. The introduction of the Wide Screen was one of several methods of enhancing the presentation of cinemas, large and small. Since the advent of 'Talkies' in 1929, there had not been any radical developments, and these new techniques gave the movies a real lift before the advent of television. But as the author of this article found out when he joined the industry, although the technology was new a lot of the equipment used to present it was far from modern.

by ROD MACLEAN, ZL2ANF

In 1955, I joined a company then known as Westrex (NZ) Ltd, which was a subsidiary of the US firm Western Electric. In turn, Western Electric was a division of the Bell Telephone Company. My title was 'Motion Picture Sound Engineer'. I was responsible for the regular maintenance of sound and projection equipment, and new installations, in theatres around the Wellington district. Much of this work was very routine in nature, but there were occasional scenes of excitement, especially when new installations were unveiled.

Western Electric had come to New Zealand, and many other countries, with the advent of the 'talkies'. It was one of a number of big US electronic firms that jumped on the bandwagon of sound films. RCA and de Forest were the two main competitors. Local NZ manufacturers came on the scene in the 1930's. Collier and Beale Ltd, a leading manufacturer of radios, produced a number of amplifiers for cinema use.

By the 1950's, all of these companies had ceased to operate in this business and their existing installations, in theatres owned by the two major chains, were maintained by Westrex.

Western Electric's early success was largely due to their system of leasing their equipment. In 1929, when the first sound films were launched, the world was entering the great depression. Most cinema operators were now faced with large capital expenditure if they were to stay in business, and the offer of leased equipment was a welcome solution. During the first three years of their operation in New Zealand, Western Electric installed 110 sound systems in theatres right across the country. In the early months, they averaged three installations per week.

The contracts that the cinema operators were offered were in the form of a monthly rental plus full service. The service involved a monthly inspection of the sound equipment, and the availability of a service engineer, day or night, if an emergency breakdown occurred.

The projection equipment used in silent films was pressed into use when sound arrived. Most projectors dated back to the 1920's or earlier.

The makes most commonly in use were Ernemann and Simplex. The Ernemann II model was very common in the Wellington area. They were very

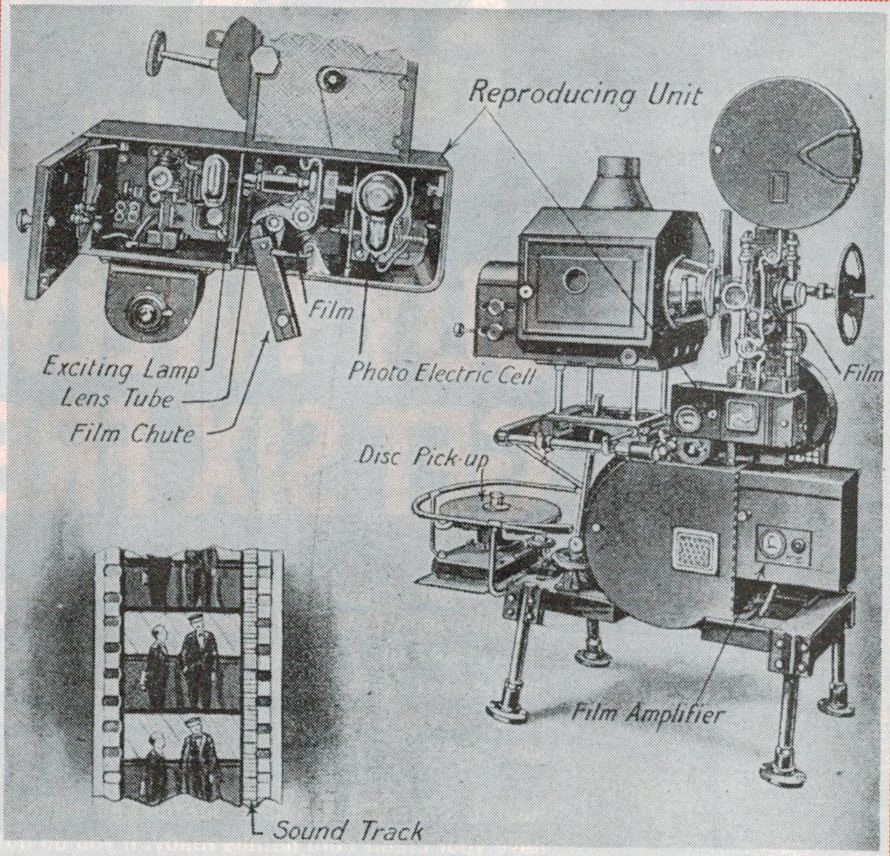


Fig.1: When sound films first came in around 1930, the Western Electric company produced its 'universal base' — to adapt existing silent projectors for sound reproduction. As shown here, it combined a base, takeup magazine, sound head, PE cell preamplifier, lamphouse support assembly and disc turntable, around which was mounted an exhibitor's existing lamphouse, projector head and supply magazine.

rugged machines, fully enclosed with a circulating oil system, and were produced by the Zeiss Corporation in Germany.

Simplex were of American origin, more lightly constructed, with the gears oiled manually through an easily accessed cover. They were very reliable and projected a steady picture.

Other makes included the Kalee (British) and the Cumming and Wilson (Australian). The latter was noted for its simple drive system using bicycle chain.

These machines were all originally driven at a speed of 16 frames per second, which was the standard speed for silent movies. With the arrival of sound, this speed had to increase to 24 frames per second — an increase of 50%.

Universal base

To enable this to happen, and to also cope with silent films that would still be released, Western Electric produced their Universal Base (Fig.1). This consisted of a cast iron platform sitting on four short legs which supported the lower film magazine and motor drives.

On top of the magazine was the optical sound head, which included a flywheel driven sprocket to provide a low 'flutter' transport for the sound track.

The optical system consisted of an exciter lamp, which was focused as a narrow slit on to the sound track. The modulated light beam was then caught by the photoelectric cell and converted to audio signals. The original silent projector, with its lamphouse and top film magazine, was then mounted on top of this setup. An assortment of adaptor drives were available to couple the projector to the sound head.

Also provided on the base casting was the 'sound on disc' turntable. This was synchronised with the optical sound head drive. The projectionist had to 'cue in' a 16-inch 33.3rpm disc with the start of the film reel. When the first talkies were released, those with sound on disk were said to have better sound quality, but the technology of the optical sound track soon caught up, and before long the turntables became redundant.

The pickup arms for these disc units boasted a heavy oil-filled head, which was also used on the 'Non-synch' unit — the record player that provided music in the interval. These were still widely used in the 1950's to play 78rpm records, even though microgroove LP records were by then well established.

The motor drive system was unique for the period. Each motor was controlled electronically, by a signal generated from its shaft, and fed back to the control box. The signal was tuned and the DC supply to the motor was regulated via four triode valves (two connected as diodes), to maintain a constant speed. This enabled the operator to set the projector speed at 24 or 16 frames per second as required. If he wanted to, he could vary the speed to suit the action of the film. This was common practice in the silent film era.

The signal from the photocell in each soundhead was fed to the Type 49 two stage pre-amplifier, mounted on the base, and then fed to a 'fader' via a 500-ohm line.

The 'fader' was a large box, with a central pointer knob, mounted between the two projectors. The operator used this to switch the sound from one machine to the other, when changing over from one reel to the next. The front scale was graduated on both sides, so that he could select the same sound level on both machines.

The signal was then fed to the main amplifier system. This was a large rack-

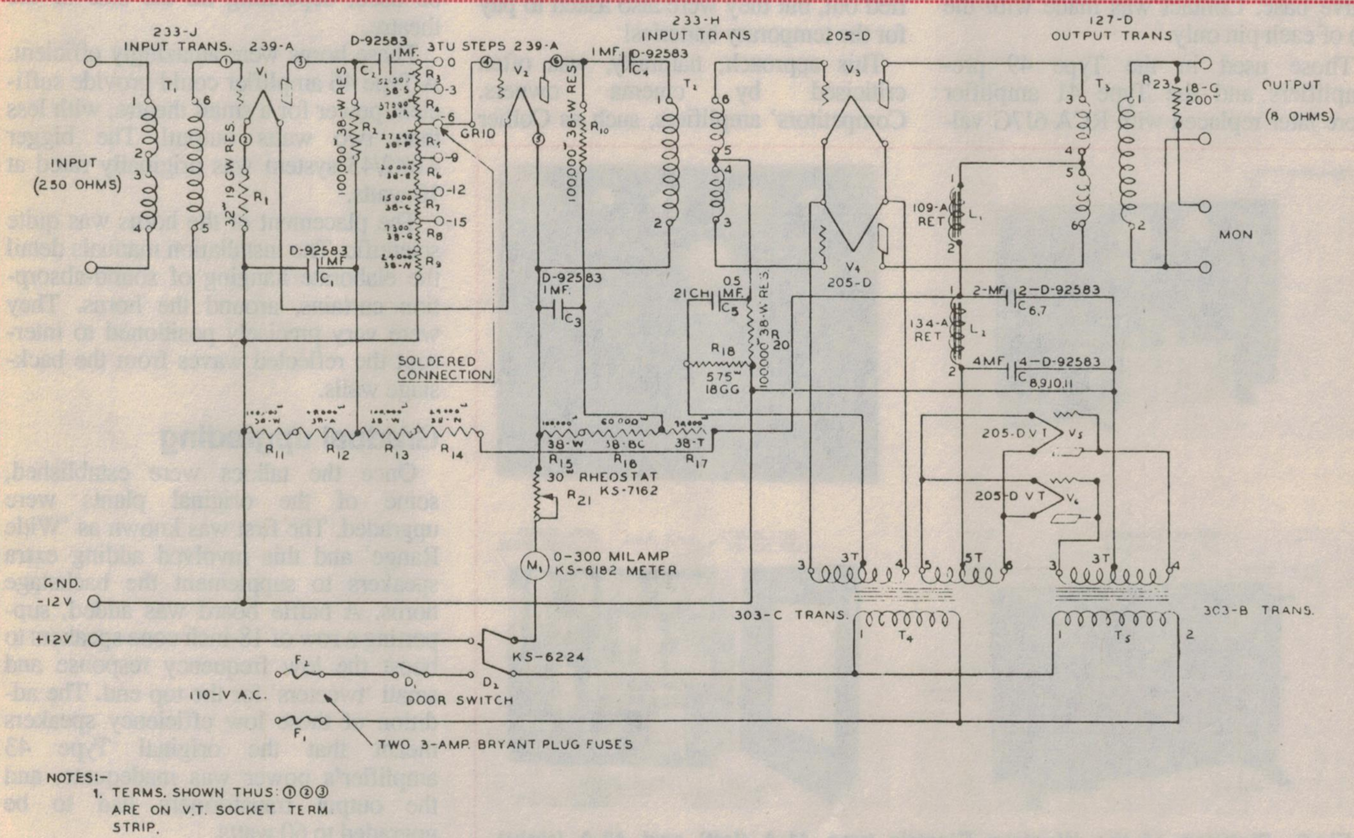


Fig.2: The schematic for Western Electric's type 46-A amplifier, taken directly from an official servicing diagram with a date of 1927. The 46-A system was intended for smaller theatres, and effectively combined a type 41 and type 42 in the same cabinet.

and-panel affair incorporating the Type 41, a three stage voltage amplifier; the Type 42, a low power push-pull power amplifier; and a high power push-pull amplifier (Type 43). Smaller theatres were fitted with a Type 46 system, which was like the 41 and the 42 mounted in the one cabinet (Fig.2 shows the original schematic). At the top of the rack was a resistance matching network for the backstage speaker system.

The construction of this equipment was extremely rugged. Chassis type mounting was not used. The valves were all mounted on the front panels and the other components, transformers, capacitors and resistors were located in boxes and linked with looms of slide-back type wire. This wire was insulated with rubber and cotton braid. To bare the ends, you merely slid the braiding back, rather than stripping it. The Bell Telephone ancestry was very evident. The construction resembled telephone exchange wiring of the period (Fig.3).

The valves used were four-pin Western Electric types using a socket of their own design. The valve was locked into the socket by a bayonet pin on the side of the valve base. Contact was made with the tip of each pin only.

Those used in the Type 49 pre-amplifiers and the Type 41 amplifier were later replaced with RCA 6J7G valves, which were more commonly available. Western Electric 205 and 242 valves were used in power amplifiers. Both of these types used directly heated cathodes. The 205 looked more like a light bulb than a valve.

Transformer coupling was used between all stages, and the design included attenuation pads in each amplifier. All valve filaments were run with a rheostat and a milliammeter in series, so that the current was kept below the official rating. These two factors allowed extra power to be gained in emergencies. If a stage failed, it could be 'patched across' (bypassed) and the loss of gain could be rectified by stepping up the attenuator and/or increasing the filament current.

The service bulletins described such emergency procedures, to be used when filter condensers failed and burnt out the power transformer. The instruction was: 'Remove the rectifier tubes. Remove the lead from the transformer and connect it to a 180 volt supply. Four Eveready layer built 'B' batteries, connected in series, are to be obtained locally by the exhibitor and furnished at his expense.'

Note the last instruction. Not only did the customers have to suffer a break in their programme whilst repairs were carried out, but they were also asked to pay for the temporary batteries!

This approach, naturally, was often criticised by cinema owners. Competitors' amplifiers, such as Collier and Beale's, were normally installed in duplicate pairs, so that the second one could be simply switched across, in an emergency. This could be accomplished by the projectionist, rather than wait for the service engineer.

The use of directly-heated valve cathodes meant that DC had to be used for their supply. The original plants had a battery supply fed by a Tungar bulb charger (Fig.4). In New Zealand this was quickly modified with a battery eliminator, which used a large bank of filter chokes and 1000uF capacitors. This was supplied by the original Tungar rectifier. This DC supply was also used to feed the field coils on the electromagnetic speaker units, and the sound head exciter lamps.

The backstage speakers were large exponential horns, driven by electromagnetic pressure units with an aluminium moving coil diaphragm — rather like the units used in public address systems. The horn was constructed of wood or sheet metal (with sound damping pads) and was exponentially shaped — i.e., it had one or two cast iron neck pieces, each with its own pressure unit, and then flared out to an opening of about four square metres. One to three horns would be used, depending on the size of the theatre.

These horns were amazingly efficient. A Type 46 amplifier could provide sufficient power for a small theatre, with less than two watts output! The bigger 41/42/43 system was originally rated at 10 watts.

The placement of the horns was quite scientific. The installation manuals detail the elaborate hanging of sound-absorption curtains, around the horns. They were very precisely positioned to intercept the reflected waves from the backstage walls.

Gradual upgrading

Once the talkies were established, some of the original plants were upgraded. The first was known as 'Wide Range' and this involved adding extra speakers to supplement the backstage horns. A baffle board was added, supporting a row of 18-inch cone speakers to boost the low frequency response and small 'tweeters' for the top end. The addition of these low efficiency speakers meant that the original Type 43 amplifier's power was inadequate, and the output transformers had to be upgraded to 60 watts.

Later, a further upgrade called 'Mirrophonic' was made. Amplifiers adopting the now more conventional technology used by RCA and others ap-

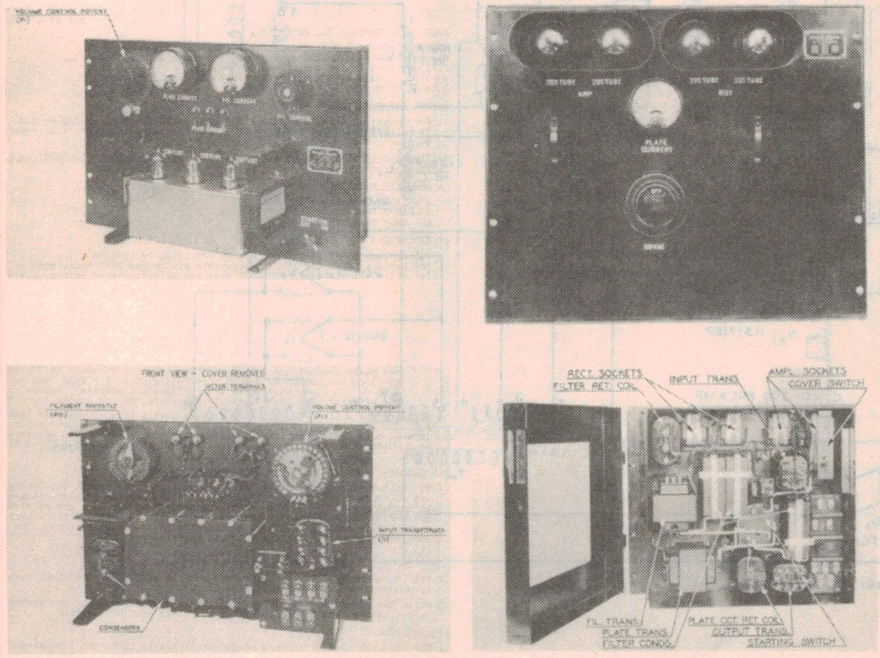


Fig.3: Pictures of the Western Electric type 41-A (left) and 42-A (right) amplifiers, showing the kind of construction used. As one might perhaps expect from their vintage, they resembled telephone switchboard equipment of the era.

peared, together with superior soundheads. Backstage systems with low frequency cone speakers and multicellular high frequency horns were also used.

Older 41/42/43 systems were also upgraded for the new backstage speakers. Once again the amplifier power had to be boosted. The low frequency speakers were mounted on a flat baffle board, with a horn-shaped surround. Felt curtains were once again used to control the back reflections (Fig.5).

Culture shock

My job prior to working for Westrex had been concerned with the service of electronic dictation equipment. This gear was very much 'state of the art' in 1955. Semiconductors had not arrived then, but the valves used were the noval type and the units were of a very compact construction.

It therefore came as a real culture shock to be confronted, at Westrex, with this ancient technology — directly-heated valves that resembled light bulbs, massive cabinets, large capacitors, chunky transformers in cast iron cases, and miles of slide-back wire. Despite this, I quickly learned that I was dealing with some highly reliable plant. Emergency calls were rare, and the majority of those were mechanical problems with the elderly projection equipment.

The only major callout that I experienced on a sound system was at a small suburban theatre. The amplifier in this case was a comparatively new Westrex one, using a fairly conventional circuit with 6L6 valves in the output. The power supply was a typical double-diode rectifier circuit with electrolytic capacitors and a choke filtering arrangement. The operator had turned on the plant for the evening show, and the rectifier valve promptly blew. He immediately fitted another valve from his spare parts cabinet, and it happened again. Undeterred, he found *another* valve and tried again. Three spare valves later, (and no more left to try), he called for help.

After I arrived, I quickly diagnosed the fault as a blown electrolytic capacitor. There was a fair chance that the now blackened filter choke was dead also. Normally, I would have bridged across the filter section with spare capacitors, which I carried with me, but since there were no rectifier valves left, I had to return to the office for parts.

I decided, while I was there, to collect an emergency amplifier which I could connect up quickly and get the show going again. On my return, I connected the amplifier and the operator started the projectors rolling. I stepped outside of the operating box to check the sound, and was horrified to hear that it had a high distortion level.

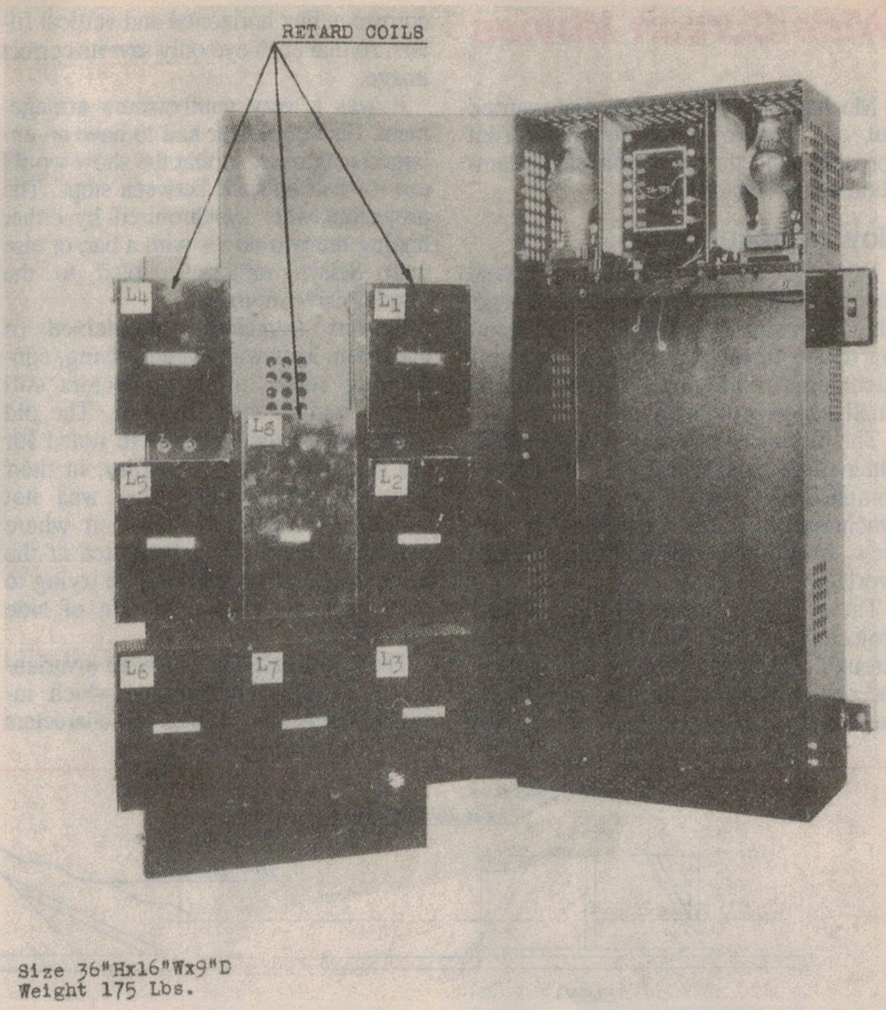


Fig.4: A partly disassembled W-E power supply unit type TA-7276, showing the Tungar rectifier tubes at the top of the cabinet.

My next approach was to get the old amplifier going again. The manager, in the meantime, elected to persist with the distorted sound. No doubt the fact that it was a double feature programme, and that it was going to be a late finish already, influenced his decision.

I wired in a new capacitor fairly easily, but the filter choke was a problem. The only replacement I could find was a load resistor used for testing power outputs. When connected, the resistor emitted a dull red glow — but the amplifier worked. At the next reel change, the incoming projector was coupled to the original amplifier, and the sound was free of distortion. I sat through the rest of the show, keeping a watchful eye on the load resistor, but it performed well and there were no more problems.

Routine maintenance was straightforward. The interiors of amplifiers were regularly cleaned of any carbon deposit generated by the arc lamps. This could be a problem in badly ventilated operating boxes. The output valves were checked for balance and a power test was carried out. This was accomplished by opening the soundhead and letting an incandescent light shine in. The AC flicker from the lamp gave a signal of 100Hz, and with a dummy load connected across the output, the power could be measured at the point where harmonic distortion appeared in the signal.

Frequency test films were run at regular intervals, and were very useful for detecting impending problems. The test range for an optical soundtrack was 40Hz to 8000Hz, with a pronounced rolloff at each end.

A specification was set for each theatre and if the test run varied from it, an investigation was necessary. Often the problem was due to oil entering the optical system in the soundhead, but the impending failure of certain bypass capacitors could also affect the curve.

Mechanical checks were also carried out on the projectors, for worn film sprockets and the operation of the lamphouses and rectifiers.

New installations

When I joined Westrex, the local cinema scene was in a state of change. The film industry in the USA was reacting to the threat of television, and was attempting to introduce features that the small screen could not match.

The first move was to produce 3-D (three dimensional) movies. This was accomplished by shooting two synchronised films, representing the view from each eye with a common overlap.

These were projected from the two projectors in the box simultaneously, through polarised filters — one vertical and one horizontal. The patrons were issued with Polaroid glasses which had corresponding horizontal and vertical filters, so that each eye only saw its correct image.

It was a very cumbersome arrangement. Each projector had to have an enlarged magazine, so that the show would run for half an hour between stops. The projectors were synchronised by either linking the two drives with a bar, or else with Selsyn motors coupled to the regular drive motors.

Patrons frequently complained of eyestrain. This was not surprising, considering some of the projectors still being used in these theatres. The old Ernemann II machines were noted for the side weaving of the film, in their relatively short gate. This was not serious on a normal film, but where two films were being projected at the same time, each eye would be trying to cope with a different pattern of side movement.

The films featuring 3-D were invariably low budget productions, which included numerous scenes of characters throwing objects at the camera. The public soon tired of these gimmicks and 3-D soon lost popularity.

Several theatres that were converted to it never actually showed any of the features in 3-D. The films were then shown as normal features with just one projector.

The next move in the battle against TV was Cinerama. This involved creating a wall-to-wall picture which gave the impression of depth, but was not stereoscopic, as in 3-D. This was accomplished by linking *three* projectors side by side, each showing one third of the picture.

Stereophonic sound was used, and the early Cinerama films were colour spectaculars, showing roller coaster rides and the like. The system was very expensive and did not come to New Zealand until some years later.

20th Century Fox adapted the Cinerama idea and came out with a most successful single film wide-screen formula called CinemaScope. They produced a screen with an aspect ratio of

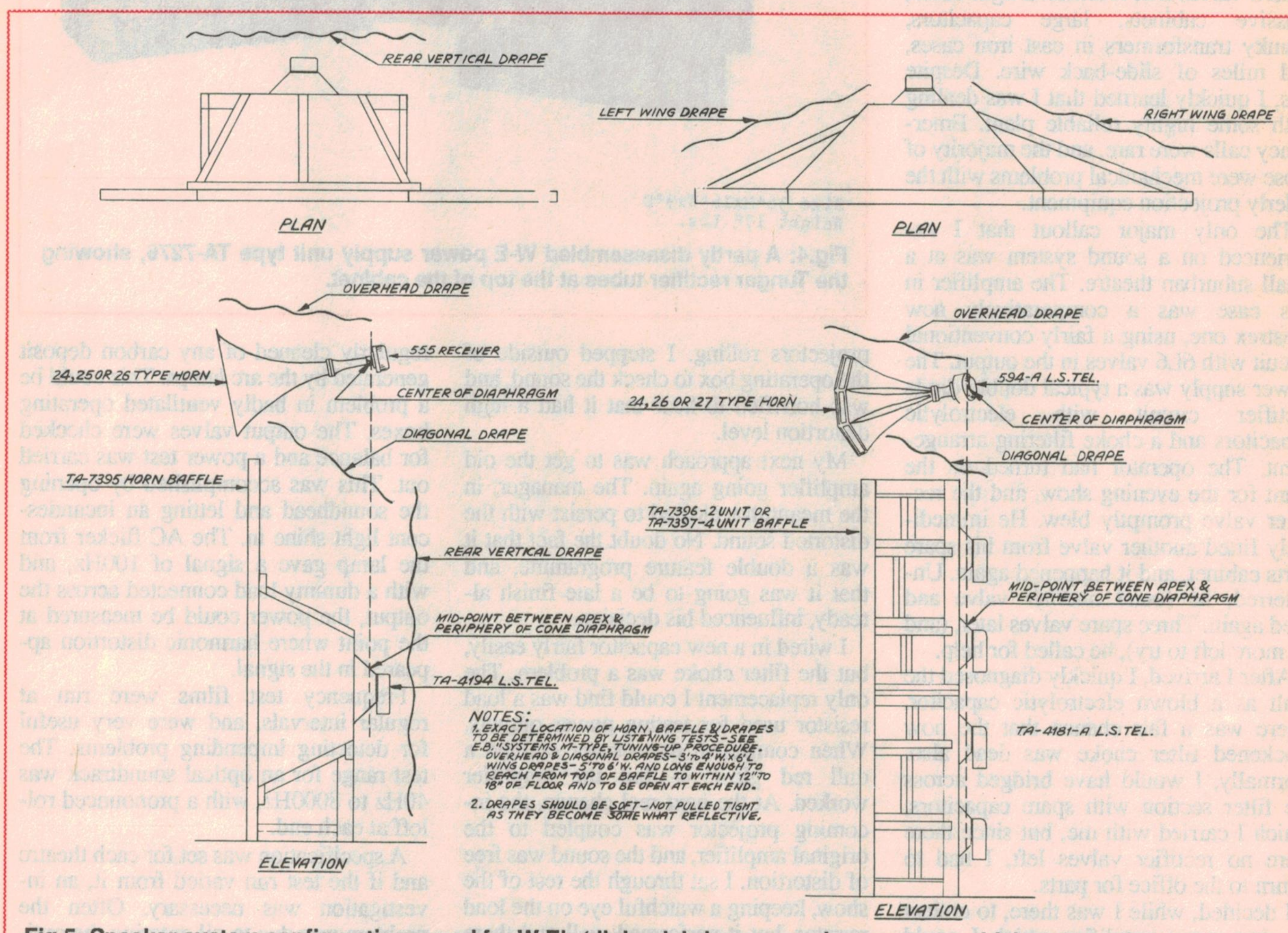


Fig.5: Speaker system configurations used for W-E's 'diphonic' cinema speaker systems, which appeared around 1937. Extensive use was made of horn loading, to take advantage of its efficiency, plus felt drapes to minimise wall reflections.

2.6:1 as against the normal ratio of 1.3:1 (4:3).

This was achieved by compressing the image on the film in the horizontal plane by use of an anamorphic lens. In the theatres, the projectors were fitted with a corresponding anamorphic lens, which was either a cylindrical lens or an inclined prism. The projected image was then restored to its correct proportions.

CinemaScope soundtracks used four magnetic stripes, and these were located alongside the sprocket holes on the film. The sprocket holes were narrower than standard and the projectors had to be fitted with special sprockets. The stereophonic sound operated through three backstage speakers and a string of hall speakers. The frequency range of the magnetic tracks was 30 to 12,000Hz, and the improvement over optical sound was striking. The magnetic sound head was located above the projector.

Amalgamated Theatres installed this system in their top theatres in Auckland, Wellington, Christchurch and Dunedin in 1953. The equipment used was all new — Westrex amplifiers and Century projectors. High intensity arc lamps were fitted, and curved metallised screens graced the auditorium. It was not long before other companies followed with CinemaScope, while some produced variants of it such as Superscope and Panavision.

MGM decided to use CinemaScope without the magnetic sound track. They introduced 'Perspecta' sound, which was a pseudo-stereo system based on switching the sound from a normal optical track to the appropriate amplifier in the stereo system. This could only be run in houses already fitted for magnetic sound. The switching was accomplished by recording three keying tones of 30, 35 and 40Hz, at a low level on the sound track. The actual switching was accomplished by an 'integrator', a massive box with a large number of 12AX7 valves in it.

If the theatre did not have stereo sound, the soundtrack would be run through a normal optical sound head as mono sound. The level of the keying signals was said to be inaudible in this situation. But unfortunately some theatres can have a natural resonance at these frequencies, and complaints of 'motorbike noises' were not uncommon. In some cases we had to fit a special filter to roll off the frequencies below 50Hz, to cure this problem.

Kerridge Odeon, the other main theatre chain, had been left behind with all of these developments, and decided to fit out their cinemas to cope with the proliferation of wide screen systems that were now emerging.

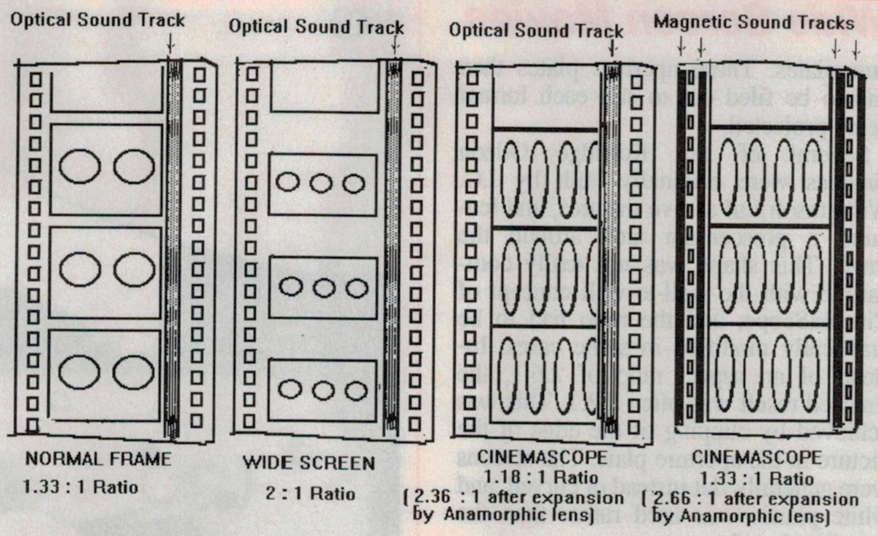


Fig.6: Some of the sound and picture formats that have been used on 35mm sound films over the years. Three different picture aspect ratios are shown with optical sound tracks, plus the CinemaScope magnetic sound print format. The variety of formats created quite a few hassles for exhibitors and their projectionists.

Paramount had just announced 'Vistavision', which was to have a 2:1 aspect ratio. This was originally shot on double-frame 35mm film running horizontally. This gave improved definition, and was shown in the USA on special matching projection equipment.

For smaller cinemas they produced a normal film version which was a masked-down print, with the picture occupying less height than a normal 35mm frame. However the increased definition of the original print was retained to a certain degree, and the end result was very good.

Also around was Todd-AO, which was shot on wide film and then reduced to 35mm film, for cinemas not equipped for it. It had a similar aspect ratio.

Kerridge Odeon owned the majority of theatres in Wellington, and many of them were small suburban houses. The old Ernemann II projectors were common, and these had to be extensively modified to run the new systems. Originally, these projectors had a blade-type shutter, which rotated in front of the lens. Later models used a drum shutter behind the gate. This had the advantage of reducing some of the heat from the arc lamps, which otherwise built up in the gate and caused film damage. The use of high intensity arcs, to illuminate the picture for the wide screen, compounded the problem. The local agent produced a modification kit, which allowed a blade shutter to be mounted behind the gate. This gave superior results to the drum shutter.

The reliability of these old silent projectors has to be admired. Here they were, some 30 to 40 years of age, after being run for 25 years at a higher speed for sound film, and were now being pressed into service, for the new wide screen technology.

Different lenses

The next problem was that the variety of systems which now had to be screened required at least three lens combinations. These were:

1. The standard lens, for the original 4:3 screen size.
2. A shorter focus lens for the various wide screen options — e.g. Vistavision and Todd-AO.
3. A longer-focus backing lens for CinemaScope, together with its anamorphic lens.

A support arm had to be added, to hold an 80mm diameter lens holder which replaced the existing one. At the end of the support arm was a large cast plate, with a central hole to support the anamorphic prism type lens.

The original gate in the Ernemann II projector had a fixed aperture opening, cut to suit the theatre in which it was installed. This aperture ensured that the projected image did not stray over the black masking around the edge of the screen.

Now, three separate apertures were required. The gate casting of the projectors had to be removed and milled out, to accept interchangeable slide-in steel aper-

Wide Screen Movies

ture plates. These aperture plates then had to be filed out to suit each format being projected.

Several of the Kerridge Odeon cinemas were originally built by J.C. Williamson Ltd as live theatres, and featured a proscenium arch around the stage. This shape was not really compatible with the wall-to-wall concept of CinemaScope, and the ratio had to be drastically modified in some cases. Instead of an aspect ratio of 2.6:1, the finished result was often 2.2:1. This was achieved by clipping of the edge of the picture in the aperture plate. The screens were generally flat instead of curved, and white plastic was used rather than the metallised surface.

The many sizes caused a few problems. CinemaScope features were issued by the film exchanges in three formats:

1. Magnetic sound track anamorphic print
2. Optical sound track anamorphic print
3. A special print for theatres not equipped with CinemaScope. This was either a normal size print or a wide screen version. (See Fig.6)

On one occasion, a suburban theatre that had not been converted to CinemaScope received an anamorphic print. The operator proceded to show it as it was, while the manager frantically phoned the agency for the correct one.

The feature was half over when the correct print arrived. One wonders how the audience managed to view the first few reels, with the compressed image. Having adjusted to this situation, it must have been a shock to revert to normal vision again!

The Censor of Films also had his problems. The magnetic sound heads on CinemaScope prints were located between the top film magazine and the projector (Fig.7). This meant that the dialogue was several frames *behind* the picture in the gate, whereas the dialogue on an optical print was *ahead* of the picture. If the Censor had to make a cut in the dialogue, it had to suit both types of print.

On one occasion, a gangster movie in CinemaScope depicted a shoot-out scene in a Japanese bath house. The gunman burst in with a machine gun and peppered the victim, who was in the barrel shaped bathtub. The water then poured out of the bulletholes like a sieve.

The Censor ruled that the scene was too violent and that the amount of shooting had to be reduced. With the constraints of making a cut to suit both type

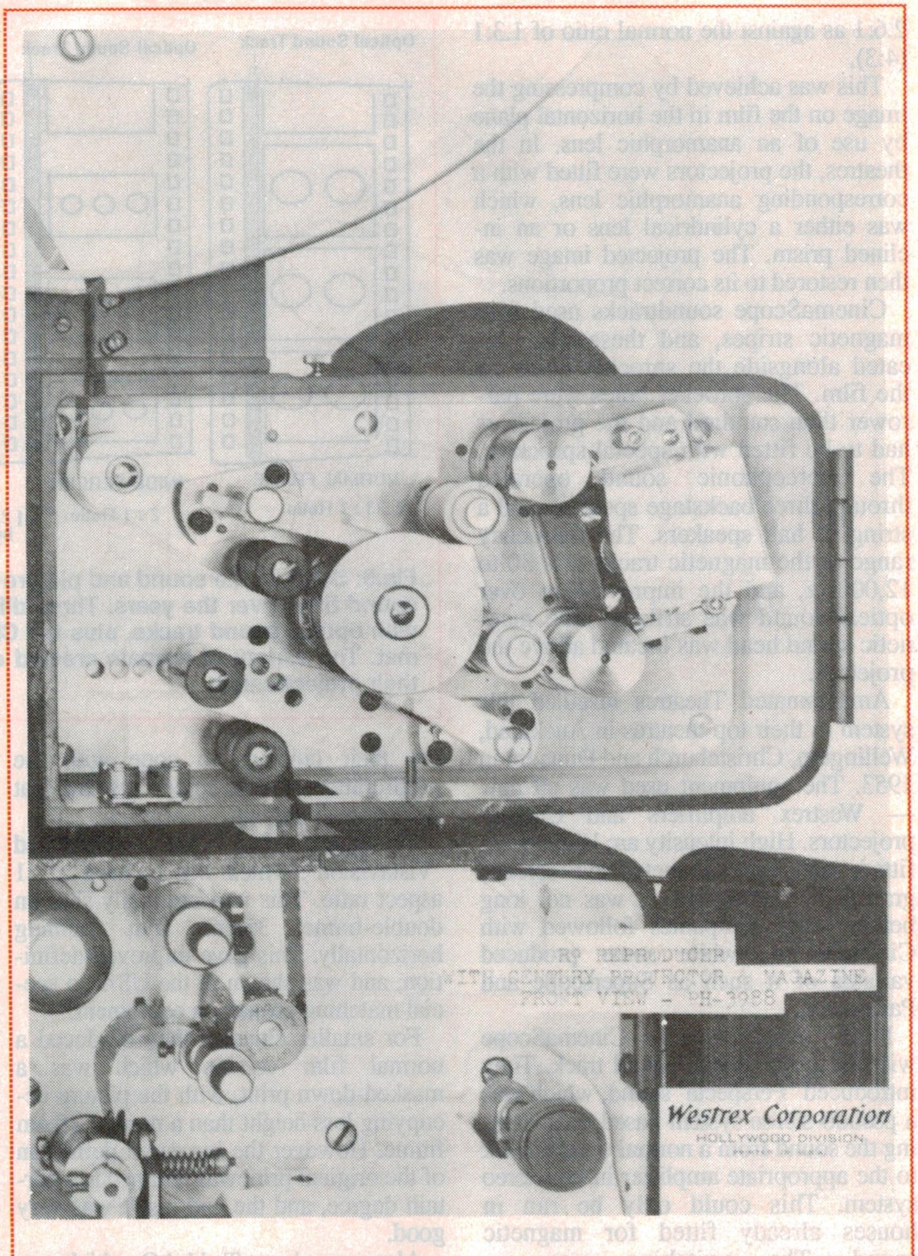


Fig.7: When magnetic sound came in, its magnetic head assembly had to be mounted above the projector's picture head because there was no room below. A W-E 'pull-through' magnetic sound head module is shown here.

of soundtrack, the end result was that the villian fired only one shot — followed by a deluge of water through multiple holes!

An era ends

The small cinemas of Wellington had their moment of glory in this period, but it was not long before TV arrived in New Zealand. Gradually in the early 1960's, the suburban theatres began to close due to dwindling patronage. Those in the central city survived longer and some new innovations were introduced, including Cinerama and 70mm film.

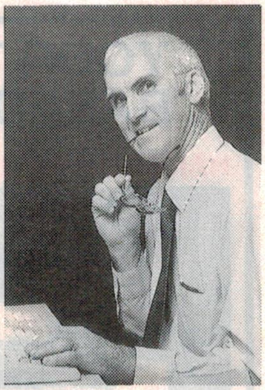
I had left the company before this decline happened. I had found that the job placed constraints on my spare time. I was frequently rostered 'on call' during the evenings and the only entertainment available was the movies.

You had to leave your seat number with the box office in case the answering service, which took the emergency calls, wanted to contact you. On several occasions, in the middle of the main feature, I was paged by the manager for a trouble call at another theatre.

Incidents like this led me to make a career move in a different direction. However I still look back on this period of my life with fond memories, of an exciting era in the motion picture business. ❖

FORUM

Conducted by Jim Rowe



Fluoro flicker, cable smear and satellite power generation

As I noted last month, the topic of fluorescent lamp safety seems to be almost as good at producing reader responses — and polarising them — as that of fancy audio cables. Our first letter this month is from a reader in NZ, offering comments on further aspects of the subject. There's also a response from a reader who believes that Brendan Jones was wrong in his claims about cable smear, and another who is understandably puzzled about last year's 'tethered satellite power generator' experiment by NASA and ASI.

Although it has a much shorter history in these columns than the topic of fancy audio cables, the one about safety aspects of fluorescent lamps has certainly shown itself capable of generating a very healthy reader response. Since it was first raised here by Frank Rushworth last November, there has been an almost constant stream of letters taking it up in one way or another — and often with some feeling. So whether we like it or not, I really can't avoid giving at least some space to it this month as well...

As it happens, the letter I've chosen to develop it a little further comes from Stuart Bridgman, a consulting engineer in Wellington, New Zealand. And as Mr Bridgman takes a fairly unemotional and matter-of-fact approach, as well as raising a few aspects which haven't been tackled by earlier correspondents, I think you'll find his contribution makes interesting reading:

I'm sure someone else closer to you will have responded before now to the interesting points you raised in Forum in the November issue. However just in case, here are my comments, for what they are worth. Incidentally I am not an electronics type, but a (relatively) 'heavy' electrical engineer, and a Past President of the Illuminating Engineering Society (NZ).

First, UV emissions from fluorescent lamps of all kinds. The 'Lancet' article your correspondent refers to is capable of being misread. The research described did NOT demonstrate any link at all between malignant melanoma and exposure to fluorescent lighting. It seems that the media only read the title of the paper, and not the paper itself!

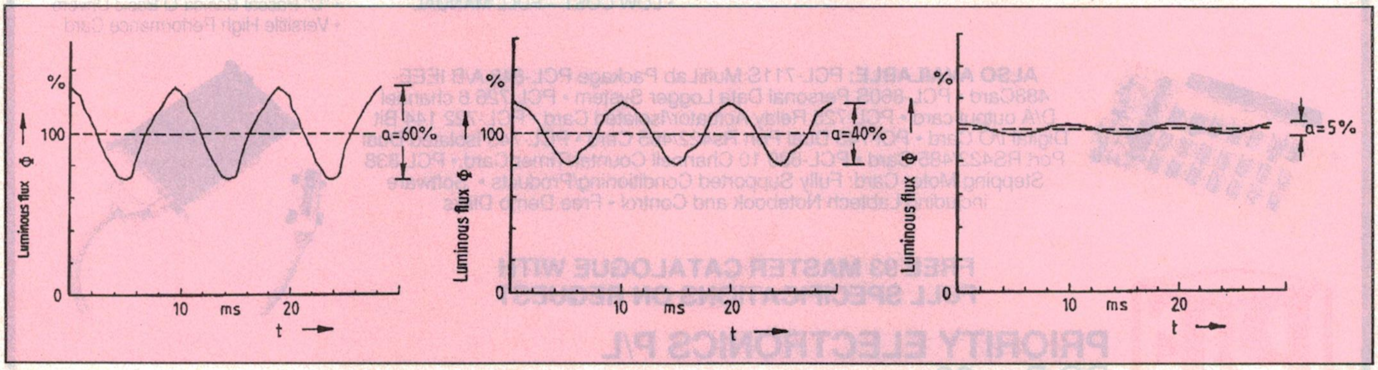
In fact, the manufacturers of a certain type of fluorescent lamp make a selling point out of the fact that their special lamp gives out MORE UV than usual. According to them, we don't get enough of this vital radiation from ordinary tubes!

I'm enclosing an article on the topic of UV and fluoros for further reading, if you're interested.

As for eyestrain and headaches, there does seem to be some evidence that these problems are more than just subjective, but the thinking is that it's due to flicker, not UV. The 100Hz flicker that you mention is there, but the light output does not fall to zero 100 times per second. Because of the persistence of the phosphors, it only falls by about 60% of the peak value. This reduces to 40% in the 'lead-lag' circuit, where alternate tubes in a litting are run with leading and lagging power factors.

This flicker is of course invisible; but it is believed to have a sort of subliminal effect that could produce headaches and/or eyestrain. The answer is to use ELECTRONIC (there, does that make you happy?) ballasts, that run the lamp at about 30 to 40kHz instead. There is still a bit of 'mains hum' left, about 5%, but this is not a problem. I am enclosing a copy of some graphs that illustrate the flicker situation.

Clinical tests in England have shown a reduction in headaches and eyestrain of 50% when a group of office workers were tested under light fittings equipped with electronic ballasts as compared to



Three curves sent by NZ reader Stuart Bridgman, showing fluoro lamp flicker levels measured by Osram. At left is that from a lamp with standard inductive ballast and starter; the centre plot shows the reduced flicker from a pair of lamps connected in 'lead-lag' configuration; while at right is the much smaller flicker from a lamp with 30kHz electronic ballast.

ordinary ballasts. This sort of result is not to be sniffed at.

The colour of the light from fluorescent lamps has undergone a lot of improvement lately and it's possible to buy tubes of 'triphosphor' type. These have colour rendering properties so good that they are used in operating theatres; and they are actually more efficient, in terms of lumens per watt, than 'ordinary' tubes. Incidentally, just about all of the latest types of compact lamps are triphosphor and are just as good for colour work as incandescent lamps.

Which, incidentally, do give off ultraviolet light to some extent; in fact the very popular tungsten-halogen bulbs, used a lot in desk lamps, have come under some criticism lately on this account. If you don't want to take any chances, the recommendation is to keep at 'a practical working distance' from the lamp. I would guess this means about one metre minimum. Check also that the lamp is fitted with a UV filter.

Finally, the energy aspect. Lighting is reckoned to consume about 30% of the electricity used in the average office building; almost all of the light fittings will be of the fluorescent type. If all of these fluoros were replaced with incandescents (which have about a quarter of the efficiency) and the same lighting levels maintained, this would increase the power consumption of the building by about 90%. The effect of this on the power generation, transmission and distribution scene, to say nothing of the greenhouse issue, simply does not bear thinking about!

Well, there you are. Mr Bridgman makes some interesting points, I think you'll agree. That point about one manufacturer of fluorescent tubes making a *feature* of their UV emission is an intriguing one, isn't it?

Competing claims...

This is expanded upon in a copy of *Varda*, the newsletter of the Illuminating Engineering Society of New Zealand (issue 1/92), which Mr Bridgman enclosed with his letter.

Under a heading 'UV Radiation from Fluorscent Lamps', *Varda*'s editor Hayden Willey compares the competing claims of 'two members of the NZ lighting industry' in 1991. Both apparently base their claims on referenced research, and use this material to promote their own product.

However as Mr Willey points out,

...one is promoting full spectrum lamps, while the other is promoting diffusers that virtually eliminate UV emissions from fluorescent lamps.

The former extols the virtues of exposure to a radiation spectrum that is similar to that of sunlight at the earth's surface. It is not only richer in red radiation than the standard Cool White fluorescent tube, but also produces much more near ultraviolet. Research is cited to support the claim of benefits from exposure to higher levels of UV than those emitted from conventional fluorescent tubes, including stimulation of circulation, production of vitamin D, an increase in protein metabolism, stimulation of the endocrine gland, a lowering of blood pressure and so on. The overall effects claimed are: improved work capacity, shortened reaction time, reduced fatigue, better learning skills and fewer catarrhal infections. The manufacturers emphasise that their lamp should not be used with UV-absorbing diffusers.

Hmmm — those tubes sound a bit like a cure for almost anything that ails you, don't they? That research on which the claims are supposedly based must be really interesting...

By the way, the same *Varda* piece also quotes the conclusions of a 1983 paper responding to the original *Lancet* paper

by Beral and her colleagues, prepared by Professors Bodmann and Ronchi of the International Commission on Illumination (CIE). The Professors conclude thus:

The present state of knowledge can be summarised as follows:
(i) As far as UV-B exposure is concerned, there is no risk of skin cancer whatsoever associated with fluorescent lighting.
(ii) There was no clear understanding of the causes and mechanisms involved in the world wide increase of malignant melanoma, and therefore fluorescent lighting cannot be implicated.

Hmmm again. Don't you just love experts like these, who make such confident claims, phrased in black and white? They're really very little different from the advertising people who claim things like 'Scientists have proved that...' or 'Doctors recommend...'

The funny thing is that most scientists are horrified by the latter kind of claim, knowing as they do that scientific experiments and research can only ever provide evidence and test theories, not provide *proof* of anything. Yet some of them seem to be quite prepared to make claims of almost identical invalidity themselves, and the summary of Professors Bodmann and Ronchi sounds very much in this category.

How could one ever justifiably conclude, on the basis of evidence, that 'there is no risk of skin cancer whatsoever associated with fluorescent lighting'? And as for their second claim, that fluorescent lighting 'cannot be implicated' in the worldwide increase in melanoma simply because there is no clear understanding of the latter's causes and mechanisms, this quietly overlooks the flip side of the same coin: that if the causes and mechanisms are not understood, then fluorescent lighting *cannot be absolved from involvement*, either.

Lack of understanding or knowledge can't be used to prove or disprove anything, of course. But where health matters are concerned, the prudent approach in such a situation seems to be to assume that there *may* be a risk, until a fair amount of evidence suggests otherwise...

Returning now to Mr Bridgman's own letter, I take his point about the flicker from fluoro's with electronic ballasts probably causing a lot less eye strain than those with standard inductive ballasts, due to the much higher flicker frequency (30kHz or so compared with 100Hz). This would suggest that the latest compact fluoro's with electronic ballasts should cause significantly lower eye strain. I'm reproducing the diagrams Mr Bridgman enclosed, to illustrate the point. They appear to have originated from Osram, in Germany. The apparent lack of a 30kHz flicker component in the electronic ballast curve must be due to an averaging or integrating effect by the tube plasma and/or phosphors, I imagine, or perhaps in the measuring system...

Finally, I note Mr Bridgman's comments about the effect on office building energy consumption if we were to replace all of those fluoro's with incandescents. This sounds fair enough, but I couldn't help but notice the contrast between these comments and those made by Ian Baker, in the November issue. Mr Baker quoted a study by the State Electricity Corporation of Victoria, suggesting that it wasn't worthwhile changing from incandescent lamps to compact fluoro's — because lighting only accounted for about 2% of energy consumption.

But there's a simple explanation of this apparent conflict: Mr Bridgman is talking about office buildings, while the SECV study was concerned with *domestic* energy consumption.

My thanks to Mr Bridgman for his comments and enclosed support information. But now let's leave this topic, at least for the time being, and return briefly to its older competitor in the controversy stakes: fancy cables.

Cable smear

As if we haven't already had enough controversy concerning cables, I've had a letter from Mr Eric Booth of Keiraville in NSW, in response to my presentation in the October column of Brendan Jones's speaker cable test results. Mr Booth's letter is quite long, and delves fairly deeply into the maths of electromagnetic cable theory. It's also in longhand, and is a little hard to decipher in places. But as far as I can see, he believes Brendan Jones was wrong, when he stated that electromagnetic theory cannot support the idea of carrying different 'parts' of an audio signal on different conductors, or the idea that there is any significant difference in the propagation velocity of high and low audio frequencies, in practical cables.

Mr Booth refers to two articles on the subject of applying EM theory to cables, one by Hawksford in the August 1985 issue of *HiFi News and Record Review* (pages 27-33), and the other by 'Joules Watt' in the February 1988 issue of *Electronics and Wireless World* (pp115-120).

I'm not sure if I've followed Mr Booth's maths correctly, but he seems to arrive at the conclusion that the electromagnetic field in a cable propagates through the dielectric at almost the speed of light, with minimum attenuation, while it travels much more slowly in the conductors (made from say copper), and has relatively high attenuation. For example he quotes propagation figures ranging from 2.93 to 58.69 metres/second (very much less than the speed of light!), for audio frequencies ranging from 50Hz to 20kHz. This leads him to make the following comments:

An electric field travelling within copper has a low velocity and experiences high attenuation, that results in skin depths significant to audio design. The copper acts as a spatial filter, so if one introduces a spatially distributed nonlinearity or discontinuous conductivity, the defects of cables become plausible. The distortion residues would exhibit a complex frequency interleaved structure that could well play to an area of the ear/brain detection process.

So — EM theory shows a cable to be a waveguide — the conductors acting as guide rails for the EM energy that propagates principally through the space between the conductors. The currents in the wires are directly a result of the field boundary conditions at the dielectric/wire interface.

Mr Booth goes on to discuss the formation in real cables of a loss field, propagating at right angles to the main field (i.e., radially in the cable), and claims to show that there is an energy storage or 'memory' mechanism, due to the relatively low propagation rate within the copper cable conductors, particularly at low frequencies. He then summarises with these comments:

It is inescapable that EM theory predicts that different cables will behave differently. The question however is: are the differences audible, and can they be demonstrated in a statistically significant manner?

...I'm sure myself that if for example loudspeaker cables and their connectors are mechanically immaculate and clean, and if their resistance does not exceed 5% of the speaker impedance — say no more than 200-300 milliohms, then any differences that exist are vanishingly small and inaudible under domestic listening conditions.

My thanks to Mr Booth for his contribution, but I confess my reaction to it must again be one of bemusement.

For example if I follow it correctly, his maths seems to suggest not only that EM theory *does* apply significantly to cables at audio frequencies, but that they should be considered almost as *waveguides* —

with the bulk of the energy propagating in the dielectric rather than the conductors. Yet every other learned authority I've read on the subject seems to say that at these low frequencies, and with the relatively short cable lengths compared with a wavelength, these cables shouldn't even be considered as transmission lines — let alone waveguides...

Mr Booth's very low figures for signal propagation velocity would indeed seem to seem to suggest that the signal wavelengths within the cable are much shorter than other experts have suggested: his velocity of 2.93m/s at 50Hz corresponds to a wavelength of only 58.6mm, while a velocity of 58.69m/s at 20kHz corresponds to a wavelength of only 2.9mm. If these figures were true, the length of practical audio cables would certainly be very significant, and would justify a transmission line/waveguide model.

But there's something about these figures that doesn't seem to ring true, quite apart from the fact that they contradict the statements of other experts. Mr Booth says himself that these propagation velocities are for propagation *within the copper conductors*, yet he says that the bulk of the propagation is within the dielectric — where the speed of propagation is very near that of light (and hence giving much greater wavelengths). Which sounds like a contradiction to me.

I can't follow his reasoning about copper conductors acting as a 'spatial filter', either. He seems to believe that this follows from his calculated figures for propagation velocity and skin depth, but the link escapes me. I'm also at a loss to understand his reference to this producing distortion having 'a complex frequency interleaved structure'.

The funny thing is that after all this, plus a claim that copper wires exhibit storage effects and so on, he still seems to come to the conclusion that the differences between typical cables are 'vanishingly small and inaudible'! Which is, I guess, what most of the other experts say as well — except that *his* maths would seem to suggest that the effects would be quite dramatic, and *very* audible...

As I said earlier, then, I'm somewhat bemused by it all — how about you?

Satellite power

Now let's change the subject (do I hear sighs of relief?), to a topic that we haven't discussed here before, although it has already created a bit of interest elsewhere. I've noticed some correspondence about it in recent issues of *New Scientist*, for example. We also published a letter about it in last month's 'Letters to the Editor' column, from Will McGhie of Lesmurdie in WA. It's about that 'tethered satellite' experiment that NASA and the European Space Agency conducted last year, on space shuttle mission STS-46. You may recall Kate Doolan's feature story about it, in our December 1992 issue (pages 26-30).

The particular aspect of the mission which has generated the interest is the claim that the tethered satellite was supposed to be used to generate electrical power — at least according to the stories in the mass media. This was never fully explained, either before the mission or afterwards, and the fact that this part of the STS-46 mission failed (due to problems with the tether reel mechanism) has only added to the confusion.

I must admit that from what I was able to read, it all sounded more like an experiment to investigate the mechanical behaviour of a satellite tether line, and also the interaction between a conducting line and any upper-atmosphere plasma, in the earth's magnetic field — rather than anything to do with power generation. In fact the prospect of using such a system didn't seem to make any sense at all, because like any such electromagnetic generating system it would simply be converting the kinetic energy of the moving satellite/tether system into electrical energy.

I gather other people had the same reaction, quite apart from having difficulty in understanding how the plasma was to be used as the path to complete the electrical circuit back to the shuttle. That was Mr McGhie's problem, I seem to recall.

More recently, though, I've had a letter from reader Ian McQueen in Tokyo, Japan, who seems to have quite a few doubts about the experiment. His letter is a bit too long to quote in full, but here's some of the more salient parts:

As I understand it, the principle was to drag a cable behind the spacecraft, and from this they expected to be able to generate an electrical current. There was no mention that I can recall about the way in which the cable-to-be-dragged was to be induced to leave the shuttle...

...Now for the electrical generation bit. I do not have access to any of my old electrical engineering textbooks, but I seem to remember a 'right/left hand rule' that related to the movement of a conductor, the polarity of the magnetic field and the direction of the resulting current/electron flow. Am I mistaken in remembering that the current/electron flow would be at right angles to the direction of movement of the conductor? So if the cable were being dragged, untangled, through space behind the shuttle, would

any electron flow not be just from one side of the wire to the other — say one millimetre, for sake of example?

If the above is true, then it would seem to be a progressive step to try to run the cable 'sideways' from the shuttle, so it would be at right angles to the direction of movement and at right angles to the magnetic field (if we assume it to be neatly rising straight up from the surface of the earth). Both of which, I am sure, are gross oversimplifications.

But let us assume that the conditions are now right for the right/left hand rule to apply, so that there is now a force trying to induce the electrons in the conductor to one end of the wire. Would we not quickly reach a balance between the EMF trying to push the electrons to one end of the wire, and all the empty sites deprived of said electrons, trying to pull them back? Expressed another way, would our long wire not be just an inefficient form of capacitor?

The part that seems to be missing is a return path for the electrons, so they can make a circuit and flow around, instead of being stranded at one end of the wire. But you can't simply connect another wire to join the two ends, because it would be subjected to exactly the same magnetic field (give or take a line of force here and there) as the main cable, so it would only add to the EMF, since there are now two conductors instead of one. I don't see how any useful work could possibly be extracted from such a system.

A further consideration is that, even if a cable could be made to generate electrical power, by a 'deus ex machina' device, it seems to me that there would be a direct conversion from kinetic energy of the shuttle mass to some other form of energy, like movement of an electric motor within the shuttle, or heat...

...But all energy converted in this manner would be reflected in a slowing of the shuttle itself, and if that continued long enough it would be as effective as a retro rocket in bringing it back to earth.

Another consideration is that if the cable could be strung out to the side, and if it could be induced (no pun intended!) to actually generate current, the force required to drive the cable through the magnetic field would have a greatly disproportionate effect on the light cable, relative to the more massive shuttle — and the cable would soon be trailing behind said shuttle.

Are my arguments fatally flawed, or could I have asked a million dollar consulting fee of the Italians and still saved them well over a hundred times that much?

Well, Mr McQueen, I think you've either missed or misunderstood some of the minor details of the experiment, but you're spot on when it comes to the crux of the situation.

My understanding is that during the proposed experiment, the shuttle was to be positioned in an orbit where the earth's gravity was still exerting a significant nett downwards pull, at the orbital velocity involved. So the idea was that this gravity would interact with the mass of the small spherical satellite on the end of the tether line, to cause it to pull the line out towards the earth, and hence at right angles to the orbital path. That's how they were arranging for the induced EMF to be acting along the length of the tether line, rather than across its width...

As for arranging a return path, without producing a cancellation of induced EMF's, what they seemed to be relying on was that this would be provided by a conducting plasma. From what I read, this would be set up as follows:

At the orbital altitude involved, there would be enough particles of gaseous matter surrounding the shuttle/line/satellite system to become ionised in response to the electric field produced by the charge flow in the tether line (a figure of 5000 volts was quoted). The degree of ionisation would supposedly cause the formation of a plasma, and hence a conducting path leading back to the shuttle end of the line. Mention was also made of a high-current electron gun on the shuttle itself, to squirt electrons off the shuttle and hence facilitate its 'connection' to the plasma return path.

Exactly how this was all going to work wasn't really explained, however. For there to be any significant electrical energy generated in this line-plus-plasma 'loop' hurtling around in an orbit that was inherently lower than a geostationary one, surely the 'loop' would need to be enclosing a significant area of magnetic field, in a plane orthogonal (i.e., at 90°) to the direction of motion. It's hard to see how the return path provided by the plasma, itself formed by ionisation from the EMF induced along the line, would obligingly 'spread out' away from the line, to achieve this.

My understanding of current flow in a plasma is that it behaves much the same as current flow in any other conducting medium — that is, it tends to take the path of least resistance, which usually corresponds to the shortest path. So in this case, you'd think it would tend to flow straight back to the shuttle, alongside the line itself...

There is still the basic problem that even if significant energy were to be generated, the whole thing is really just a fancy way of converting the kinetic energy of the shuttle/line/satellite system into electrical energy. No energy comes from the magnetic field, just as none does in a more conventional generator. In fact quite a bit of energy would probably need to be fed into that electron gun, to make that connection to the plasma.

So Ian McQueen is quite right, as far as I can see, in saying that the system is more a fancy braking system for the shuttle, than a way of generating electrical energy. I suspect he's probably also right in saying that there would be a reaction force acting on the tether line and satellite, as soon as you tried to extract any of the generated energy, so that it would soon be trailing behind the shuttle — or at least at some oblique angle, due to the combination of gravity and reaction forces. Even this would reduce its effectiveness quite markedly.

In short, then, like Ian McQueen and others I can't see how this kind of a setup could possibly be used to generate power. But perhaps we're ALL missing something. Is there anyone out there who can put us straight? ❖

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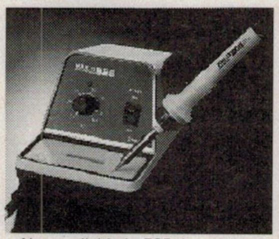

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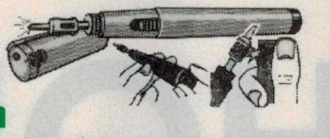

See review E.A. April 88. No cords or batteries yet it gives the equivalent of a 10 to 60W iron. Up to 90 minutes continuous use from a single fill. Tip temperatures as high as 400°C can be set. The kit includes one soldering tip, a hot knife, blow torch and hot blow. Cap contains a flint lighter. Comes in a handy case (with stand for the iron) almost fits in your pocket.

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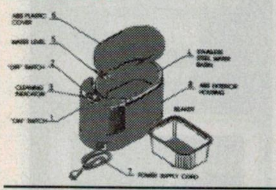

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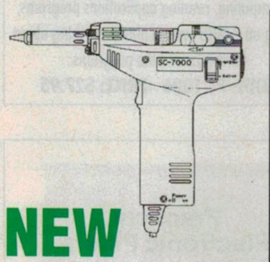

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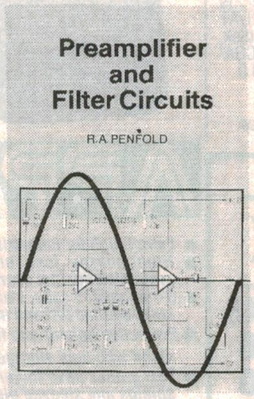

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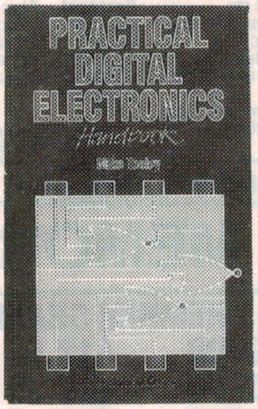

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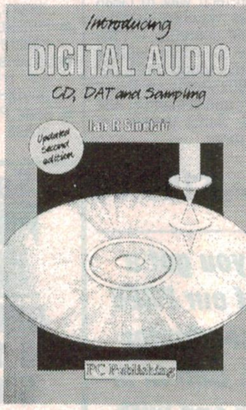

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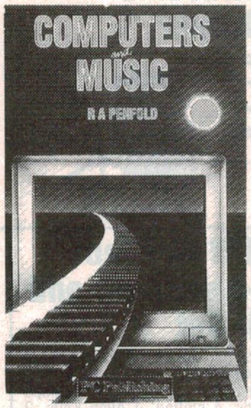

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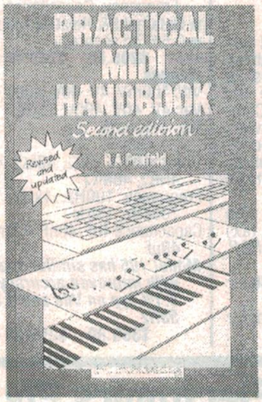

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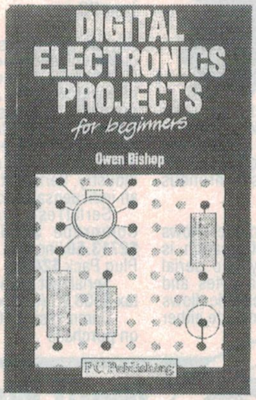

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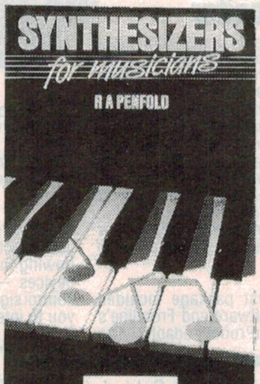

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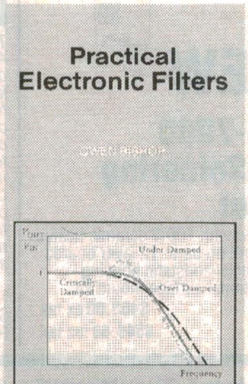

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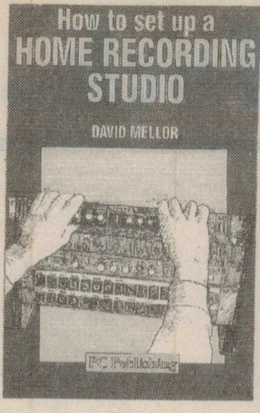

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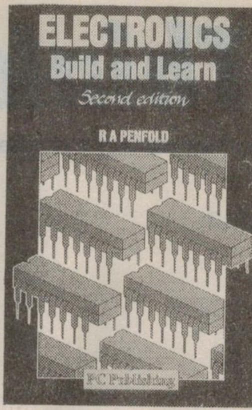

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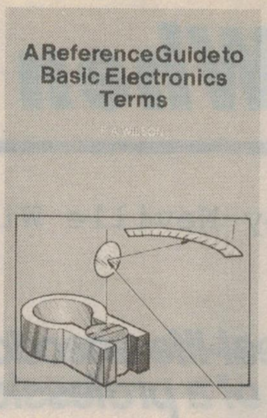

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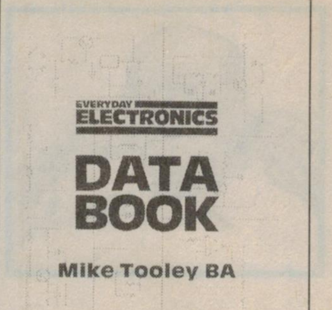

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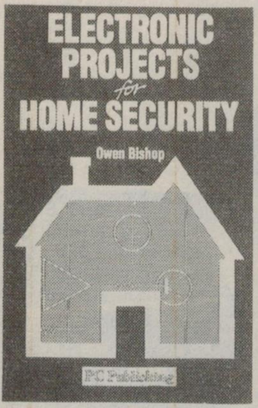

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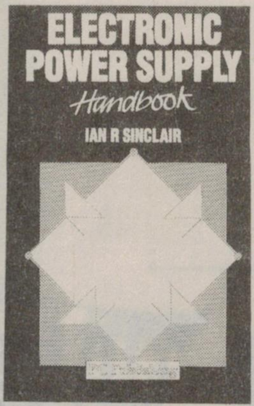

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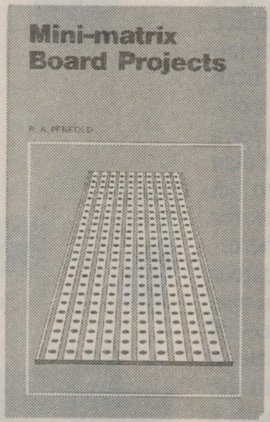

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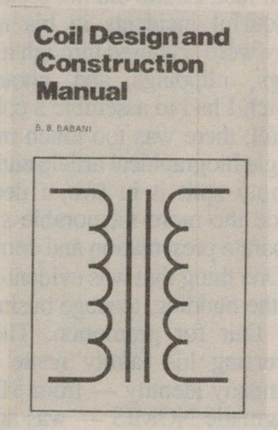

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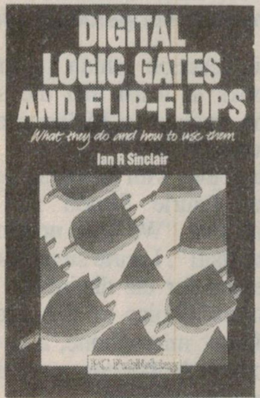

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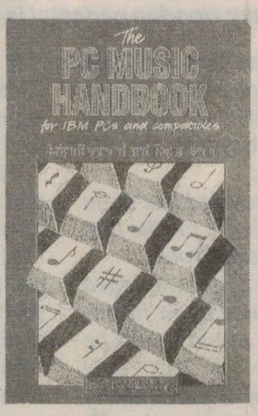

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When I Think Back...

by Neville Williams

PA systems - 3: Real-life anecdotes from the memoirs of a professional

After building a career and a company around the design and installation of public address systems, it is not surprising that Laurie Simon, featured in the second of these articles, can recall incidents that were variously gratifying, salutary and amusing. They should prove an eye opener to readers whose involvement in PA has been confined to the amateur/enthusiast level.

In fact, Laurie did not seek to segregate colourful incidents in his memorabilia; they were scattered through a sheaf of jottings, clippings and photostats from which I had to assemble a cohesive story. In all, there was too much material for a single biographical article and, rather than simply split it in two, I decided to set aside the more memorable sidelights for separate presentation and comment here.

One thing that was evident in the career of the budding, teenage businessman was his flair for promotion. The device of reversing his family name to create a company identity — from SIMON to the enigmatic NOMIS — was an example. I say this because, as one who has a penchant for forgetting names, Simon/Nomis prompts a ready recall.

With this as a starting point, he insisted that the logo, displayed vertically, be routinely bracketed to the performer's mic stand, where it would become part of the overall picture — on stage, in press photos, in newsreels and ultimately on television. It was never seen to better advantage than in the press photo of a young Prince Charles, in last month's instalment.

For home town Adelaide, the ploy worked to perfection. Backed up by a reputation for committment and reliability, 'Nomis' came to mind almost automatically if sound amplification was required in that part of the world. During and after the event, all concerned were aware who had done the job.

When Adelaide railway station was fitted out with PA in 1938, *Radio Review of Australia* for April of that year featured the key role of the Nomis Radio & Amplifier Co, along with their choice of Australian Rola's sensitive and powerful G-12 loudspeakers.

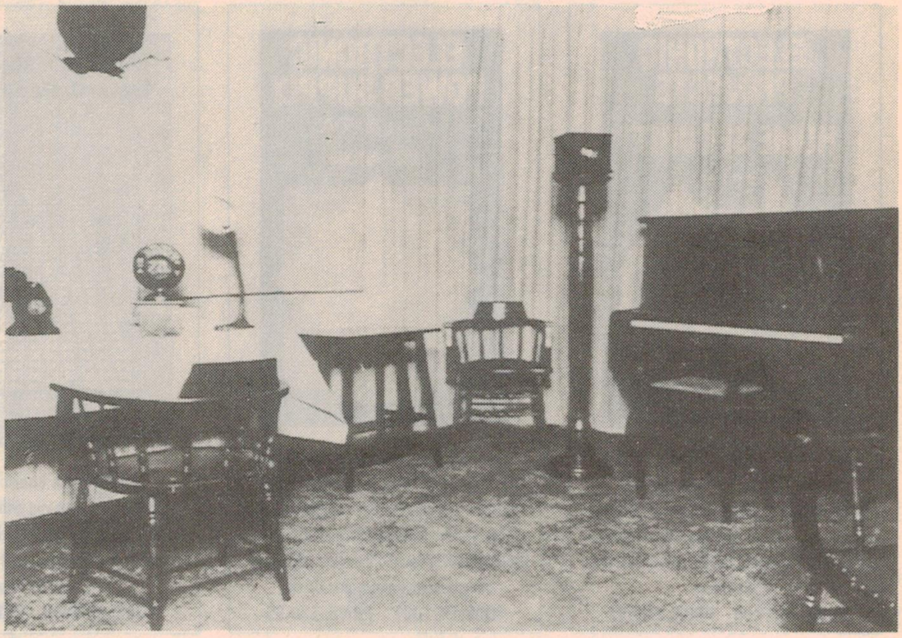

Fig.1: 5CL's studio, as it once looked. The condenser mic, in its forbidding wooden box atop a heavy wooden pedestal is at centre rear, alongside the piano.

Again, reporting on the first Adelaide concert of Richard Crooks (*The Advertiser*, September 4, 1936), H. Brewster Jones led off with a bouquet for the amplifier system. I quote:

West's Olympia was crowded last night with an enthusiastic audience for the first Adelaide concert of Richard Crooks.

Although the famous tenor employed the most delicate pianissimos in falsetto, and sotto voce, the sound could be heard in every part of this vast auditorium by means of a particularly efficient public address system — locally constructed. Only two of the four amplifiers installed were in use, but they were evidently sufficient.

It was this reaction which prompted Richard Crooks to insist that the same equipment be trucked to Melbourne for his farewell concert there.

This was together with his personal appreciation of Laurie Simon and his remark to him that "We have nothing in the States like that!". Laurie suggests that the prime reason for the distinction was probably Nomis' choice of a broadcast quality condenser microphone, at a time when most other PA operators were using much less pretentious types.

Royal commendation

But even the distinguished Richard Crooks' commendation paled before

Royal endorsement. Among Laurie's papers I came across a letter on official PMG stationery dated GPO, Adelaide, 23 March, 1966. It was addressed to Mr L Evans, Nomis Electronics Pty Ltd, of 419 Black Rd, South Forest, SA. (Mr Evans was Technical Works Manager, having been with the company for 25 years.), and reads:

Dear Mr Evans,

At Government House last night the Private Secretary to Her Majesty, Lieutenant-Colonel Sir Martin Gilliat, commented most favourably on the quality of the public address system at the Adelaide Town Hall and said that Her Majesty had told him that it was one of the best public address systems that she had ever used.

These remarks were endorsed by other members of the Royal Household and the State Director. This, of course, reflects considerable credit on your company and in particular on you and your staff concerned on this occasion and it gives me pleasure to pass these comments on to you.

I wish to express to you my personal thanks for the cooperation which you gave me in arranging the facilities at the Town Hall and I trust that we may again be associated on some future occasion.

(Sgnd) B.R.Perkins.
COMMUNICATIONS OFFICER,
ROYAL VISIT, 1966.

Now back to the condenser microphones mentioned earlier. As indicated last month, Laurie bought the first two from the PMG Dept in the mid 1930's, after they had been pensioned off from radio station 5CL in Adelaide. Thereby hangs a tale...

From studio to stage

At 5CL, the basic condenser capsules had been housed in rectangular wooden boxes (17 x 15 x 17cm), being large enough to accommodate a one-valve battery powered preamplifier.

A faded photograph (Fig.1) depicts the original studio scene, including one of the actual mics bought by Laurie Simon, perched atop a massive wooden stand beside the piano. It seems implicitly to convey the message: "Not to be moved indiscriminately; to be sung at — not into"!

PMG technicians were not impressed by Laurie's proposal to expose their revered studio microphones to the rough-and-tumble of public address — especially when he indicated his intention of exposing the capsule on a conventional mic stand, with a two-metre long twin shielded lead to the preamplifier nearby.

The capsule, they said, would simply not stand up to being handled and puffed into by stage performers; and while the shunt capacitance of the extended lead may not affect the tonal quality, it would certainly reduce drastically the already low output signal level.

Fig.2: Four historic mics from Laurie Simons' collection. Clockwise from top left: One of the original condenser capsules; an STC 'Eightball' with baffle fitted; STC 'Saltshaker' dynamic' and finally an Astatic D-104 crystal.

Laurie says that one of the men who tried to talk him out of the idea was Frank O'Grady, at the time Chief Engineer of the PMG's Department and later Postmaster-General.

In truth, all parties were probably 'right'. For Laurie, the move paid off handsomely — but not without dire consequences, as predicted. I quote from Laurie's hand-written notes:

In studio work they seldom gave trouble. Many times, however, I had nerve-wracking moments. Due to breath condensation, the diaphragm (rolled aluminium, stretched) would develop minute holes through corrosion. Close-up crooners caused most of the trouble.

Typically, one might be operating at an important luncheon with a notable guest speaker. Suddenly one would hear a couple of ominous 'spits', signifying a flashover between the diaphragm and the back plate. Would it hold out until the end of the speech?

Laurie's response was to ensure that capsules could be interchanged in a minute or less, and for the operator always to have a spare on hand.

Back at the factory, Nomis was fortunate to have an ex-PMG employee on staff, who could roll and fit new diaphragms as needed.

High quality important

In their day, studio-type condenser mics underscored the importance of audio quality, but Laurie was not backward in seeking out other types that could be used in specific situations without the attendant risk of voltage breakdown. (Fig.2)

Dynamic mics were obviously attractive, by reason of their low output impedance and their ability to work into lengthy shielded cable runs. In this context, Laurie said that he also came across a small high-to-low impedance transformer which could be inserted inside the casing of some crystal microphones, to enable them to operate into a long balanced/shielded cable — much like a dynamic.

This led to mention of an occasion when a D-104 crystal mic was selected for a prestige luncheon with a notable speaker. In normal circumstances, the installation would have been appropriate for the speech-only occasion, with the rising response of the mic ensuring crisp diction in the particular environment.

The preliminaries went off without a hitch but, unfortunately, the guest speaker's sibilants were grossly accentuated. Says Laurie: "Maybe he was running-in a new set of dentures, because every time he hit an 'S' the sibilant emerged as a whistle. Our speech amplifiers, at the time, had provision for bass cut but not top cut, and there was not a thing I could do about it".

Problems could arise, says Laurie, in

even the most tightly controlled situations. For example, Nomis was commissioned to supervise the entire sound arrangements in the Adelaide Town Hall for a visit by Prince Charles. Everything had to be duplicated, as a precaution against possible breakdown. Program splits also had to be provided for radio and TV stations.

On stage, separate twin microphones had to be provided in specified positions, one pair for the Governor and Lord Mayor (both rather short men) and another pair, adjacent to the prompt facilities, for Prince Charles (much taller). They were preset to precisely the specified height.

The first hitch occurred when, just before proceedings got under way, the amplifier system was found to have developed a sudden and mysterious hum. It was tracked down to a piece of broadcast station equipment, which had been plugged in using an unbalanced line transformer. The offending tech had to tear off to locate an acceptable substitute.

But there was more to come. Overlooking prior arrangements, the Prince walked to the wrong microphone to address the audience in a less than forceful voice — with the microphones pointed directly at his tiepin! There was a frantic twiddling of controls by all concerned in an effort to compensate, without running into acoustic feedback.

'Mic shy' performers

Laurie was obviously put off by guest speakers who had an aversion to microphones — a sentiment that would surely be shared by anyone who has been responsible for the operation of a PA system.

The difference is that Nomis was commonly involved with very public figures and a large and/or influential audience, with a poor result being a potentially bad advertisement for the company: "The mic wasn't working properly", and so on...

The wife of one very prominent government figure was a large lady with a small voice. She was scheduled to address several hundred teenage girls in a park situation, where a platform and amplifier had been set up.

On arrival, the good lady informed Laurie in a stern voice that she hated 'those things' (microphones) and would not be needing the amplifier.

Affecting equally stern tones, Laurie drew her attention to the considerable noise level from nearby traffic and pointed out that, without amplification, she would be heard only by those nearest the platform. Much against her will, she accepted his advice.

Their next encounter was at the Adelaide Town Hall, where she was guest speaker at a large girls' school function. The Headmistress used the amplifier system for the introductory speech and Laurie assumed that, in the light of their previous encounter, the guest would be wise enough to follow suit.

But no, 'her ladyship' deliberately avoided the microphone and proceeded to share her pearls of wisdom with those who happened to be in the first couple of rows.

Nor was this attitude confined to the fair sex. A similar situation occurred at the break-up function of a prominent boys' school, in a large picture theatre with suitably damped acoustics. The headmaster delivered his annual report and proceeded to introduce the guest speaker — a prominent parliamentarian.

With an imperious wave of the hand towards the microphone, he said "I hate those things!". Then, raising his voice:

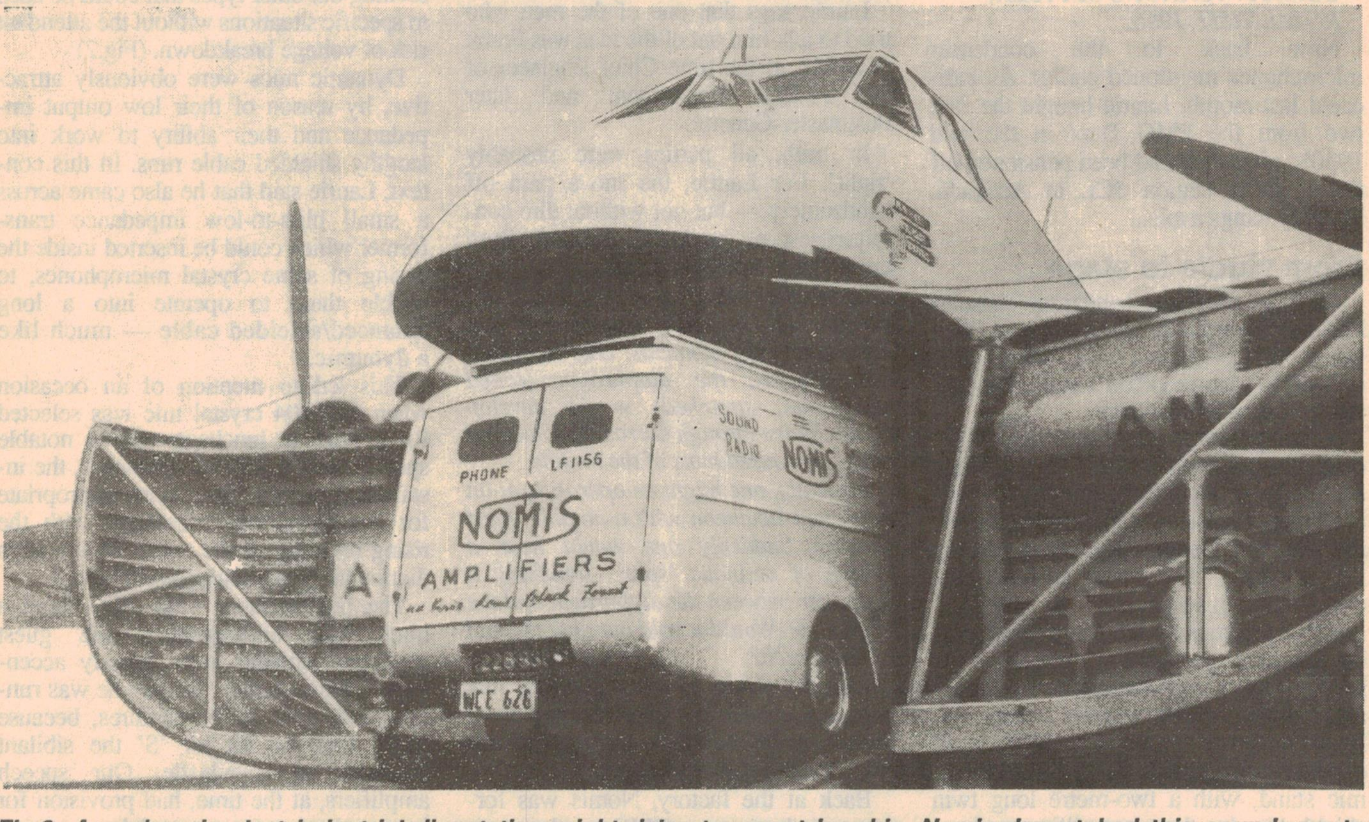

Fig.3: Apprehensive lest industrial disputation might delay transport by ship, Nomis despatched this sound van to Tasmania by Bristol freighter from Melbourne's Essendon airport. It was critical to adequate sound coverage of a Royal visit to Hobart and Launceston in 1954.

"Can you hear me?" From somewhere up the back came: "No!". Encouraged by the laughter, he carried right on. Laurie was one of the few who heard what he said — primarily because he was in the orchestra pit with the PA system, unable to correct the situation.

Somebody must have told the politician later about his wasted effort, because next time their paths crossed at an exclusive girls' college function he "almost swallowed the mic at times", such that Laurie had to 'ride' the volume control for the duration of his speech.

Design consultants

In the early days, says Laurie, such incidents were almost par for the course, with any number of people professing to be up-tight about microphones. He had also had more than his share of architects who were uncooperative in the choice and placement of amplifier equipment — and more recently, of consulting engineers with a certain amount of theoretical knowledge but little in the way of practical experience.

Then again, as mentioned in the January issue, there were/are churches and similar groups who ended up in trouble when they failed to realise that unsatisfactory sound is often due to poor diction or poor microphone technique, rather than to a deficient amplifier. Laurie's next story indicates just how involved such a situation can become.

Back in the early 1960's, Nomis installed a PA system in what he decribes as a 'beautifully designed medium size cathedral-like church'. It had no ceiling as such, but a Gothic style roof structure, timber panelled from the top of the walls to the lofty peak.

As part of the system, Nomis had installed two sound-column loudspeaker systems, up front with one on either side. The obvious intention had been to project the sound out over the congregation from the general direction of the pulpit and to minimise projection into the roof area, where it would be likely to create echoes.

Results at the time appeared to have been acceptable. But for reasons best known to the membership, they had later set up a technical(?) committee from within their own number, to devise ways in which the sound might be improved still further. Instead, the committee made matters worse and, in the course of time, Laurie Simons was invited back to suggest where they had gone wrong. When he walked in, he could scarcely believe his eyes. An acoustically absorbent ceiling had been erected at wall height, completely closing off the elegant Gothic roof. A new PA system had been installed, with complex loudspeaker wiring and controls and facilities well beyond their needs.

Gone, too, were the up-front sound columns. Instead, there were round holes in the ceiling, each one accommodating the trumpet of a re-entrant metal horn facing vertically downwards — horns that would have been more at home "strung around a dog track!". Said Laurie: "I shuddered to think what it had all cost".

And pity help the unfortunate communicants who ended up directly under the horns — as they watched participants out front moving their lips while a disembodied metallic voice crackled from the ceiling above. Elsewhere in the auditorium, the congregation would have had to do its best with a babble of metallic, disembodied voices! How the communicants finally resolved the problem, Laurie didn't say.

The great outdoors

But he did include two or three incidents from the days when Nomis had to cover outdoor events the hard way — without ready access to AC mains.

One such event was a large picnic function where there was no mains power on site. However, he was told not to worry about a battery-powered supply, as one of the organisers lived close by. He need only bring 'about so many yards of flex', and pick up mains power from the organiser's home. Unfortunately, the organiser underestimated the distance.

But again, he proved helpful: run your flex as far as it'll reach, and get on with setting up the gear. He had extra flex in his garage, he said, and he'd join and tape the two together. They'd done this sort of thing before...

The only trouble was that, when he plugged in and switched on, there was no power at the amplifier end.

Seeking the reason, Laurie tracked back along the cable, alert for any obvious physical damage. When he came to the join, it was generously taped — but it also felt strangely warm! So did the rest of the cable back to the house, even though it was in free air, draped over shrubs.

It didn't take long to sort out what had happened. The helpful householder had dutifully twisted the wires, colour to colour, but he had omitted to tape them separately. He'd simply bundled them all neatly together and taped them as a group!

Laurie remarked that the householder must have been using a hairpin or nail in place of fuse wire. His meter must really have taken off when he switched on. After the join was correctly re-taped, a good time was had by all!

Aeronautical guidance beams

I would like to acknowledge reader comment on my story in the August 1992 issue about aeronautical radio navigation beams, and in particular, the German Bomber Command's 'Knickebein'.

C.J. Petrich (VK4ACZ) of Mt Molloy, Qld, comments on the evolution of radio beams since then, and the trend setting Boeing 247D which he first encountered at Bahrain. As a purpose-built postwar airliner, it stood out from an assortment of converted wartime bombers being pressed into service by aspiring operators.

His main theme, however, has to do with Dr R.V. Jones, featured in the August article, who was largely responsible for neutralising the potentially dangerous Knickbein guidance system being used by marauding German bombers.

Mr Petrich points out that Dr Jones subsequently wrote an informative book entitled *Most Secret War* — a publication that I was not previously aware of. Jones apparently featured also in a postwar BBC documentary under a similar title. He should thus have been better known than I allowed for.

Still further information on Knickebein was given in *The Ultra Secret*, a book by Fred Winterbotham — Jones' wartime boss, whose role, according to my correspondent, was glossed over in Jones' own account.

Again, Jones received passing mention on page 25 — and a footnote — of Peter Wright's controversial book *Spycatcher*. Wright acknowledges that Jones had made a brilliant contribution to the war effort, but suggests that he was widely mistrusted by the 'old boy' network in postwar Whitehall. This was by reason of his single-minded independence. I quote: "If we let him in, he'd be wanting to run the place next day"!

That Jones had a high regard for the amateur fraternity is evident, according to my correspondent, in his *Most Secret War*. Rowley Scott-Farnie G5FI receives frequent mention. The British amateur fraternity, Jones says, furnished an invaluable reserve for the staffing of radar stations and signals networks and for signals intelligence personnel.

Jones tells of a discussion, postwar, with General Martini, Head of German Signals and Radar. He was intrigued, he had said, by the high standard of engineering evident in German communications equipment, in contrast to the very limited technical standard of their operational personnel.

Martini's reply was that Hitler had suppressed amateur radio before the war, and disbanded the potential reserve of technical and communication skills. Of necessity, German equipment had to be so engineered that it could be operated and maintained by relatively unskilled personnel.

The second letter is from Wal ('Blue') Easterling, a correspondent and again an amateur from Burleigh Waters, Qld. He says that the operator on the Anson which ultimately confirmed the existence of Knickebein was Corporal Mackie, reputed to be a pre-war 'ham'.

The signals had been missed previously, because the RAF simply did not have a suitably sensitive receiver capable of tuning above 30MHz. Corporal Mackie was using a Hallicrafters, obtained from a London dealer on credit. That sounds like an amateur to me! Thanks again, Wal.

Fumes and dogs

Tired of mains supply hassles and/or organising heavy duty accumulators and DC/AC inverters, someone at Nomis came up with the idea of mounting an AC generator in the engine bay of a Chevrolet-6 panel van.

They would use the van to transport the equipment to the site, park it in a suitable position, fit the alternator drive belt and generate their own power on the spot. If exhaust fumes proved a problem, they could be dealt with by adding a length of flexible hose to the normal tailpipe, to carry them downwind.

The idea worked like a charm — until summer came around, and the engine had to be periodically spelled to prevent overheating! The 'last straw' came when someone forgot to load the hose and Laurie had to spend hours with the truck, attending to the alternator and equipment, in an atmosphere loaded with carbon monoxide. "I arrived home", he said, "as sick as two dogs!"

Mention of dogs is appropriate as an introduction to Laurie's final, somewhat earthy anecdote. It involved a race meeting at Snowtown, under very primitive conditions. There was no local power or other facilities and the Nomis van was parked on the flat, with a loudspeaker atop the cab directed towards the modest crowd of patrons grouped mainly around the finishing post.

Power for the system was drawn from heavy-duty 32V batteries, driving a DC/AC rotary converter which fed an amplifier and a radio tuner. Local announcements came from the course 'office' via an ancient telephone hook-up, while Laurie was supposed to cut in city race broadcasts picked up by a tuner in the truck.

Unfortunately, as the time for the first such broadcast approached, Laurie realised that the signal was being blanketed by noise interference, mainly due to commutator hash from the rotary converter, but aggravated by a makeshift aerial and an ineffective earth. There were no buried pipes to latch onto, and the ground was so dry that the plated earth spike might just as well have been a wooden tent peg!

If only a couple of the local dogs would wander past and douse it with what we schoolboys used to call 'potassium-phosphide' — K9P. But there wasn't a dog in sight. In sheer desperation and alone on the far side of the van, Laurie duly summoned all his resources and did what he had to do!

What's more, it worked. As he said, it was "a magic fix"! They got their broadcast.

From this remote time and place, I can only concede that, faced with a vexing technical problem, Laurie had come up with a solution that, if not unique, was unlikely ever to have featured in a formal textbook. As I said: 'an earthy anecdote' indeed!

That aside, my thanks to Laurie Simon for a glimpse of the trials and tribulations of a pioneer PA professional. In so saying, I'm conscious of having created an opening for would-be raconteurs from the next generation, who have been involved with PA during the postwar years.

There must surely be 'roadies' amongst our readers, who once managed and man-handled ear-shattering equipment for itinerant rock groups. There may even be the odd engineer who looked dubiously at Laurie Simon's 805's and ventured into the uncertain world of solid state. It's over to you. ❖

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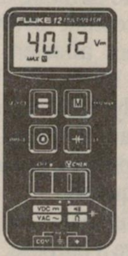

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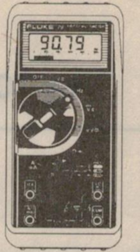

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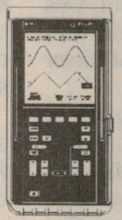

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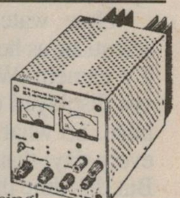

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Moffat's Madhouse...

by TOM MOFFAT

Fibre optic follies?

Around 20 years ago, as a television journalist, I was called to a press conference at Melbourne University. At least that's where I think it was; it was a long time ago. We were to be shown something that would *revolutionise* communications, or so the press release said. Nothing amazing there; just about every press release had the word 'revolutionary' in it somewhere.

Everyone rolled up to this small lab. There were a couple of tables with some test equipment on them. Also on one table was a television set, and the other held a closed-circuit TV camera on a tripod. On the floor, in the middle of the room, was one of those big Telecom cable reels, with what looked like lots of layers of silver wire wound on it.

Each of the journalists was given a small white envelope containing a few strands of the 'wire' that was on the reel. "Don't stick yourself with it", we were told. "It's glass, not wire. Glass fibre. Optical fibre."

I took out one of the strands, felt the sharp tip, and promptly stuck myself with it. A quick pain, a single drop of blood, and a place in history as the first television journalist to get stuck with fibre optic cable.

"Now watch this", said one of the scientists, as he popped the lens cap off the TV camera. We immediately saw ourselves displayed on the TV set on the other table. So what? We saw ourselves on TV every day; that's what we did for a living. But this time the TV signals weren't going along a cable, or through the air — instead they were going along a single strand of glass. So what? We're all used to cables. That glass looks fragile, breakable, and after all you can stick yourself with it...

At this stage one of the scientists launched into a lecture about things like carrier frequency and bandwidth, perhaps not the best way to convince the lay press of the technological marvel at hand. There were yawns and lighting of cigarettes, and thoughts of when the beer would finally be handed around.

But I had been brought up in the Bell Telephone system, amidst cables that could carry 1860 telephone conversations at once, or one television channel. Carrier frequencies meant microwave systems of 2GHz or maybe 10GHz, still with that limit of 1860 telephone circuits. And these guys were talking about using a laser beam as a carrier, bouncing it along in a 'light pipe'.

Now what's the carrier frequency of a laser beam? Its wavelength is a few hundred nanometres; what's its frequency in GHz? Pretty damn high, that's what. So high that its modulation bandwidth isn't limited to 10 or 20MHz, but more likely 10 or 20GHz — maybe a thousand times as high. So that limit of one television channel on a strand of coax can become 1000 television channels on a strand of glass.

So what? Well, a new broadband carrier system could be established across Australia, all on strands of glass. So who cares? Only Telecom — certainly not the general public. At least that's what the news editor said, when I came back raving about this fantastic story I'd come across. It was just Tom on a technology kick again. But I finally got a pretty good version of it to air, mostly by persistent nagging of the film editor.

I felt I'd seen something with truly great potential, but I couldn't exactly figure out what it was. Nevertheless I kept that little envelope with the glass strands in it as a souvenir; I've still got it to this very day.

Today we learn that Australia's telecommunications utilities plan to run a strand of that fibre optic stuff into every house in the land, probably before the turn of the century. That means each and every one of us will have access to our own broadband bearer system, capable of carrying hundreds of TV channels or untold thousands of telephone circuits, between home and the nearest telephone exchange. Each local exchange will have more fibres linking it to a central exchange, central exchanges will have intercity links, and the big cities will have international gateways.

At my end, by sending the correct digital sequence along my strand of glass, I will be able to order up a high-definition TV link between my lounge room and the home of my dear old pappy back in the USA. We can have a face-to-face talk, via VIDEO PHONE! There you go, it will finally be practical.

But what to do with hundreds of TV channels? Well, the first thing you can do is forget about the Pay-TV system as it is being proposed now. None of this direct satellite into home broadcasting; we won't need it. Send the Pay-TV signals along the glass.

I think you can also forget about free-to-air television as we know it. Our soapies and sitcoms will still be free (although laden with commercials), just like we know them today. But they'll come to us along the glass, just like Pay-TV. Reception everywhere will be perfect — not affected by ghosting or weak signals like today. Television channels, currently limited to 6MHz or so bandwidth, can be spread out to whatever is needed to provide photographic colour-slide picture quality.

Big powerful television transmitters will no longer have a purpose. They will disappear from our mountaintops and from the airwaves, leaving space for the burgeoning mobile communications services that are clamouring for spectrum space. FM broadcasting will continue to use big transmitters because of the mobile nature of its users.

One of my money-making schemes of years past was wiring up new houses for any type of communications or control that might be wanted in the future. There was seldom any definite plan, the homeowner just wanted to cover the possibilities.

I would pick just the right day during the house's construction, when the studs were in place but no internal walls had yet been fitted. I could then zip around with an electric drill and a big roll of twenty-pair telephone cable, running a cable from every room in the house, through the studs, back to some central point such as a big cupboard or a pantry. Here was mounted a standard Telecom-style 'frame block' on which every pair of every cable was terminated.

Once the house was finished, the owner could then run a short jumper from say pair 12 of the main bedroom to pair 8 in the kitchen, and then use the line for any purpose at all. It was a piece of cake to have telephone extensions anywhere you wanted, or an intercom to every room, or music from the stereo in the family room extended to a pair of speakers in the bedroom.

This fibre optic thing seems to me to be much the same scheme, on a global scale. Should I find some obscure need to have a full-time communications link set up between my home in Hobart and perhaps some building in Albury, it should be possible to do it with a simple digital command. After all there are thousands of 'pairs' in the 'cable' running to my house, and thousands more in the 'cable' to the other building in Albury. The communications utility simply 'ties them together', electronically, and when the link is no longer needed it can be pulled down again.

Networks will be a snap. Should my business become big enough to benefit from having offices all around Australia, a few software commands could establish some common channels linking all our fibre optic cables. We could all be connected to one central computer, full time. We would have full time voice lines, maybe even full time video lines. We could have a meeting at 10 o'clock each morning, without anyone needing to go anywhere.

All these things of course are possible now, if you're prepared to pay for them. But with current technology that pretty well excludes them from all but the biggest businesses. What I'm talking about is small stuff — an outfit with one or two people in each city. With so much capacity provided by so many optical fibres, supply should certainly exceed demand and prices, I suspect, will fall to what we pay for a simple dial-up telephone connection today.

Will this be of any use? Well, nowadays much of the stuff I write for *Electronics Australia* is sent from Hobart to Sydney electronically. When I've got something to send, Editor Jim Rowe and I establish a telephone connection between our two computers.

Because of line constraints, I then send my story at a snail's pace of 300 bauds while we both stare at our screens, watching the block numbers tick over and willing the line not to crash until the transfer is finished. It takes around 10 minutes of telephone time, with all the fiddling about, to transfer a two-page item like Moffat's Madhouse.

Should I wish to communicate with *Electronics Australia*, I usually send a fax. But if they want to talk to me, they must phone because my primitive fax system can only send, not receive faxes.

Ten years from now, assuming *EA* haven't given me the flick, I will have a full time fibre optic link between the computer next to my desk and Jim Rowe's computer sitting in the corner of his office. When I've got copy to send, I'll just press a function key and the item will instantly be sitting there on Jim Rowe's hard disk, ready for editing. I've heard it said that fibre optic technology will let you send two Sydney phone books in a fraction of a second. A 2000-word Madhouse column will be like a grain of sand, in the dust storm of all this information flow!

As for that miserable fax thing in my computer, I can chuck that out. When I want to communicate with *Electronics Australia*, I'll just press another function key and Jim Rowe's smiling face will pop up on my computer screen where my word processor used to be (oh, No!). And he will see me, monocle and all.

There will also be dedicated links between my computer and any other magazines I happen to be working for. What could be fun would be to bring up the editors of two opposing magazines, connect them together, and watch them swear at each other. (It was possible to do this to people 20 years ago, and it was jolly good fun. I'll tell you about it sometime. Stay tuned.)

There could be some interesting times for electronic enthusiasts, when everyone has mega-bandwidth optical carrier system terminals in their homes. Radio amateurs have 'terminals' now, in the form of their transceivers. They can send voice or data out, or receive voice or data coming back. With the correct terminal equipment (packet radio), data of all kinds can be shuffled all around the world, although slowly.

It seems possible, with fibre optic technology, that anyone who was interested could possibly have a several-MHz wide chunk of bandwidth allocated to them on their fibre optic connection on a send-and-receive basis. This same piece of spectrum could also be fed into the homes of other people interested in experimenting. Users could then connect any weird and wonderful gadget, which would affect only other people of similar interests.

Such an arrangement could replace amateur radio as we know it. The band would then be open to anywhere, anytime.

But that would remove a lot of the fun, too, of experiencing strange propagation with on-air signals. And there's another factor: with amateur radio, we pay an annual licence fee and then we can toss a signal into the air any old time we feel like it. Somebody, somewhere, is going to hear it, and nothing on earth is going to stop it.

With fibre optics, or any point-to-point communications system, someone else 'owns' the physical stuff the signals travel through. You must pay that someone to use the medium, and if they don't want you to use it, it's a simple matter to cut you off. If the price goes up, you pay or perish.

In times past, when something horrible has happened in a country, be it political or natural disaster, there has always been a way for someone to get on the radio and yell for help from the rest of the world.

If the authorities try to silence a dissident transmitter, it just pops up somewhere else. But once fibre optic technology spans the world, governments will be tempted to ban the private ownership of radio transmitters. What an efficient way to silence those who won't toe the government line...

But then, perhaps the old skills would come back. During World War Two, any radio tech worth his salt could cobble together a transmitter in no time, most likely from the carcass of a defunct broadcast receiver.

I remember at ham radio conventions many years ago, there used to be competitions in which teams raced to see who could be first to turn an old mantel radio into a transmitter. Maybe it's time to start teaching that stuff again... ❖

THE SERVICEMAN

Two different CTV's that simply WON'T work with the same vertical chip!

I have a really mixed bag for you this month. There's an explanation of some terminology that puzzled a young colleague of mine, another little story about an accident that might have had dire consequences (but didn't), and a very handy tip about sets with remote control problems. And our main story concerns two different models of colour TV, which just *don't* seem to like their vertical scan chips replaced with the same type — only with a different type, after you've amputated one of its pins...

Our first story is one that probably should be in Neville Williams' 'When I Think Back' column, but since it came about in a servicing situation, I'm going to mention it here.

I was helping a young apprentice TV technician to sort his way through a complicated colour television circuit. The particular problem concerned the loss of the main power rail — or as I'm in the habit of calling it, the 'B+' rail.

At first, I took no notice of the fact that he too was calling the rail 'B plus', just as I did. He even called ground 'B minus'. For some time neither of us noticed anything unusual about this nomenclature, but he must have been thinking about it because suddenly he turned to me and said "Where is the A plus rail?"

The question made me realise that anyone less than 70 years of age could probably ask the same question, with just as much innocence.

We have become so accustomed — especially those of us of mature years — to referring to the main power rail as 'the B+' that it takes quite a conscious effort to recall where the term originally came from. Even in the olden days of valves we always talked of B+, long after A plus and C minus had disappeared.

As I explained to my young friend, there was once a time, so far back that even I can't remember it, when all radio sets were powered by batteries.

Most sets required three different batteries. There was a large, low voltage but relatively high current battery to run the valve heaters, or 'filaments' as they were called in those days. Then there was a high voltage, low current battery to power the plates, as the valve anodes were called. Finally, there was another low voltage but low current battery to provide the negative bias needed for the grids, especially those of the audio output valves. For convenience, these batteries were labelled 'A', 'B' and 'C' respectively.

The 'A' battery was commonly a lead-acid type, quite often a six volt car battery. (That shows how old this story is — how long since you saw a 6V car battery?) It was called on to supply from two to four volts at a couple of amps, whenever the set was in use. Unless a family had its own battery charger, it was somebody's weekly job to load the battery into the kid's billy cart and take it down to the garage to be re-charged.

The 'B' battery was usually built up of dry cells, a hundred or more of them in series and was fitted into a stout cardboard carton. The battery had to supply something like 130 volts at 100 milliamps. For the amount of listening enjoyed by the average family, one of these batteries would probably last about a year.

Finally, the 'C' battery usually consisted of six dry cells connected in series. It had a row of spring connectors on top so that an appropriate bias voltage could be selected for the particular application. These batteries delivered anything from 1.5 to 9 volts, but at effectively zero current. As a result, the 'C' battery lasted a very long time indeed. I recall recently reading of one of these batteries recovered after 50 years, and still capable of delivering its full rated voltage!

So, how come we still talk about B plus rails?

Well, when valve manufacturers perfected the indirectly-heated valve, it became possible to power the heaters from the mains via a 'battery eliminator'. That did away with the need for an 'A' battery.

And it wasn't long before set makers built the battery eliminator right inside the set, doing away with the need for a 'B' battery.

The 'C' battery persisted a little longer, but soon circuits were devised that did away with even that long-lived relic of the then recent past.

So, from the 1930's onwards, it became possible to ignore the 'A' and 'C' supplies in domestic radio receivers. If the valves lit up the A supply was OK, and the C supply arrived automatically as soon as the output valve began to draw current.

Only the B supply remained of any concern, and then only to the serviceman. Because it was a high voltage supply, and because high voltage components in those days were relatively unreliable, servicemen seemed to spend most of their

time chasing the loss of high voltage, or 'B-plus' as it was convenient to call it.

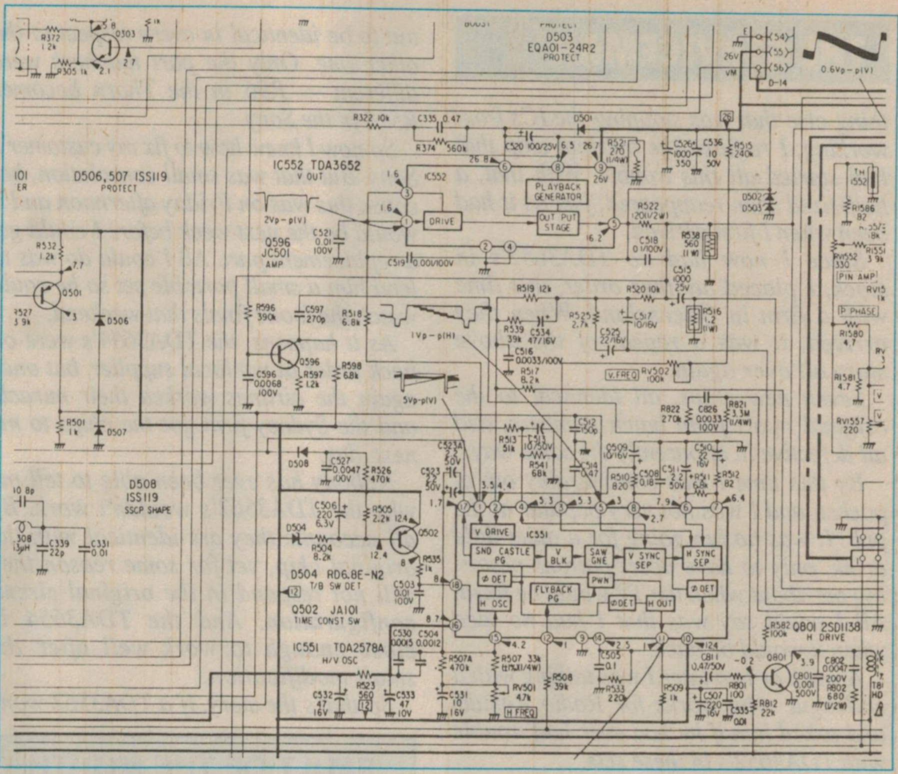
So from about 1930 to around 1970, when valves finally disappeared from the domestic electronics scene, 'B-plus' was used to designate the main high voltage rail in valve sets. In TV sets, where there was usually a need for several different high voltage rails, they were often called B1, B2, B3 etc. But note, they were still 'B' something.

Nowadays, with transistors and IC's calling for voltages in the range that was once the province of the 'A' battery, why don't we refer to the main rail as A+?

Well, somewhere along the way the designation shifted from specifying voltage to outlining purpose. In other words, it ceased to mean the high voltage rail and began to refer to the main supply rail, irrespective of voltage.

So today, my young friend follows a B-plus rail, in so many respects similar to the one that was once powered by two cubic feet of series-connected dry cells!

Now, back to more modern matters.



Part of the deflection circuitry of a Sony KV-2764 colour TV, showing the synch separator and H/V oscillator chip IC551 and the TDA-3652 vertical output chip IC552. It is the latter device that appears to present compatibility problems.

Incompatible chips?

This story comes from A.K., of Blackmans Bay in Tasmania. It's A.K.'s second appearance in these pages. A few months back, you may recall, he told the story of a Sony that killed its sound chips. This time another Sony comes into the picture, but only after a long and frustrating battle with a Thorn. Sound complicated? Well, here's how A.K. tells it:

Recently I had a call from the owner of the local pub. He wanted me to have a look at one of their TV's in the public bar. All he could tell me was that the set was showing only half a picture.

The set in question was a Thorn TX100, made in New Zealand and imported by Radio Rentals. The hotel bought it from RR when the rental agreement ran out, and I have serviced it on a couple of occasions since then.

The fault description wasn't very clear about which half of the picture was visiwle, but I took a gamble that it was suffering a partial vertical collapse caused by a fault around the output stage.

I consulted the circuit diagram and learned that the vertical output is built around a TDA3652 IC and as luck sometimes has it, I had one of these in stock. So I put it in the toolbox and headed for the pub.

On arrival, I was pleased to see that my guesswork was accurate. The set was suffering from partial vertical collapse and from the appearance of the image, I suspected that one half of an output transistor pair in the IC had failed.

The barman helped me get the set down from its high shelf, and onto a table where I could work in comfort.

The removal of the cabinet back and extraction of the appropriate circuit board went quite easily, and I was looking forward to a quick and easy job.

I soon had the old IC out and the new one in, then switched on, confidently expecting to see a full sized picture filling the screen. So I was most surprised when I found I had normal sound but no sign of a picture — not even the half-sized one that I had begun with!

I checked the picture tube to be sure the heaters were still working, and I checked for EHT. Both seemed normal, so I turned up the screen voltage and then I saw the trouble — a thin white line from side to side. The new IC was a dud!

So, I told the barman I couldn't finish the job until I had got a new chip, and that was likely to be "...some time tomorrow". We decided not to put the set back up on the shelf, but to leave it in an unused back room. I had no wish to strain my back, heaving it up and down again for no good purpose.

Next day I got two new ICs from a local supplier and went straight back to the hotel to finish off the job. I removed the 'new' chip that I had fitted the day before, and soon had one of the new ones in place. With exactly the same results.

I couldn't imagine that two new chips, identical except for their batch numbers, could both be faulty in the same way. So I fitted the second of the chips I had bought that day. And would you believe, it was 'faulty' too!

At this point I had three faulty chips, all TDA3652 but from two different batches. It's not unheard of for new IC's to be faulty, but it is extremely rare. So I decided to get a new supply, from somewhere far away and likely to be from yet another different batch.

And to minimise the embarrassment that was developing about this job, I loaded the set into the wagon and took it back to my workshop. I prefer to work without impatient drinkers worrying me with enquiries about when the set would be ready...

I had to order the new chips from a Sydney supplier, but such is the marvel of modern airfreight that the package was on my doorstep first thing next morning.

After checking everything I could think of around the output stage, I fitted one of the new batch of ICs. With exactly the same results.

Chip number four wouldn't produce any kind of scan, and neither would chip number five. The five ICs had come from three different batches and from two different suppliers. Yet none of them would work in this chassis.

Just to be certain that it wasn't some-

thing else that was stopping the ICs from working, I re-fitted the original chip that had started all this trouble. With that, a half-sized scan reappeared, just as it had been when I first arrived.

Since I now had no TDA3652's in stock, I placed another order, this time with a firm in Queensland. When they arrived, it was a repeat of the above story all over again.

Seven new chips, all identical to the original apart from batch numbers, and all defective in apparently the same way.

By this time I was considerably out of pocket, and I was not very popular at the pub. It was no fun going for a quiet little drink, only to have upset patrons pestering me about when the TV would be fixed. All I could say was that I had no idea when it would be back.

A week or two later I was talking with a colleague who works for Radio Rentals and asked him if he had ever had trouble with TDA3652's in these sets.

He knew of nothing like the trouble I was having, but he did recall that they once used a TDA3654 as a substitute for the 3652. The only changes needed were to cut off pin 7 from the 3654, and to reduce R96 from 6.8k ohms to 3.3k.

In some desperation, I ordered a TDA3654 and lost no time fitting it when it arrived. I changed R96 then switched on, barely hoping that something good would happen.

It did! Up came a near-perfect picture. It needed a few minor adjustments to linearity and height, but was otherwise a brilliant result.

After a two-day soak test, I was able to return the set to the hotel and patch up my relationship with the other patrons. (It's nice to be popular!)

All of the above story happened about three months ago, and might have been forgotten if another set had not reminded me.

The new job was a Sony model KV2764 EC, with a similar type of failure. The picture had collapsed to about half the height of the screen.

I checked the circuit diagram for details of the vertical output stage and learned that it also used a TDA3652 — although at this point I didn't connect it with the earlier story.

I replaced the chip, only to have a repeat of the TX100 fiasco. There was absolutely no trace of any deflection whatsoever.

At this point I recalled the details of the Thorn story and began a detailed inspection of the Sony circuit. It turned out to be identical in every respect to the other one. Only the part numbers were different — R96 in the Thorn becomes R518 in the Sony.

So now I knew how to fix my customer's Sony. But that was small consolation, because this was on Friday afternoon and it would be the next week before I could get a replacement part. All I could do was to lend him a small portable set so he could watch the footie finals that weekend.

As it happens, the TDA3654's were on back order at my local supplier, but once again the airlines worked their miracle and the Sydney firm got the chips to me next day.

Nobody has ever been able to tell me why the TDA3562's wouldn't work. By all accounts they are identical with the original chip, yet for some reason they will not respond in the original circuit configuration. And the TDA3654 is close enough to work well after the small modification.

So that's the story. If a TDA3562 won't work, amputate pin 7 from a TDA3654 and change R96/R518 to 3.3k ohms.

FAULT OF THE MONTH

JVC HR7200 VCR (and clones)

SYMPTOM: Cuts out a few seconds after starting to play. No takeup reel rotation, but the fault is not the reel idler.

CURE: Reel drive belt has become misplaced or broken. This machine uses the reel idler only for FF and REW. For normal takeup, the reel is driven by a belt from the capstan shaft. It can slip, or become misplaced, or break — any of which can cause the machine to stop.

This information is supplied by courtesy of the Tasmanian Branch of The Electronics Technicians' Institute of Australia (TETIA). Contributions should be sent to J. Lawler, 16 Adina Street, Geilston Bay, Tasmania 7015.

Thanks, A.K. As I read your story, I couldn't help but think that there must have been some subtle fault in the Thorn that stopped the correct chip from working. I couldn't accept that all seven brand new chips were faulty, and the only other explanation would be that there was something wrong with the set.

But when a second, different brand of set produced the same result, I just had to give up speculating. I don't know the answer and I can't even draw up a likely scenario. Does any reader know what's different about later versions of the TDA3562?

Oops — sorry!

Now we have a short contribution from a reader in 'memory mode'. He is G.B., of Crafters in South Australia. G.B. doesn't say when this incident occurred, but I suspect that it was quite a few years ago.

I was interested to read, in a recent 'Serviceman' column, the article about the power station being controlled by a torch battery. It reminded me of a similar incident.

I was working on the telemetry system that controls the remote operation of gas turbines used to send gas to Adelaide from a distant gasfield. The telemetry was quite old, and used lots of fixed logic chips to carry out a packet protocol from the main computer in Adelaide.

The other technician and I had removed the modem card and were testing the system locally with a test box. It was about 1.00am when we finally finished repairing the system and my friend asked me to send a 'Station Alert', to see if the output relays worked.

A station alert is a simple hooter alarm, to let the compressor crew know that the control centre in Adelaide wished to contact them.

I set up t he address on the test set and pressed the transmit button. The hooter did not go off, but there was an ominous click from a relay behind the control panel.

Suddenly some indicator lights began to change state and the unmistakable sound of a gas turbine firing up became apparent.

"What command was that!?" asked my colleague, looking a little worried. I ran my finger down the list and felt a little sick myself when I realised that it was a 'Start Unit A' command that I had sent by mistake.

These turbines are fearsome things, originally designed to power aircraft. By this stage the turbine had wound up to operational revs, giving the familiar high-pitched whine. I did not know at the time that the machine was safely controlled by a PLC (programmable logic controller) after the initial contact closure. I had visions of valves being closed and dangerous pressures building up. The turbine room sounded horribly close.

My friend grabbed the phone and called control, asking them to stop the turbine. At first they were skeptical. "How on earth did you manage to start it, anyway?" They accepted our anxious explanation and tried to send a 'Shut Down' command. "We don't have communication with that site" came the reply.

My friend and I looked at each other, and then at the modem card lying on the bench. It was clearly past our bedtime. He quickly pushed the card into its slot and the control centre shut the beast down.

I guess that the moral of the story is

that even though the system uses an elaborate packet telemetry system with error checking, it can still be overridden by humans working locally.

It makes me think of all those missiles lurking in silos around the world. Let's hope the 'Start WW3' button is not adjacent to the 'Test Fire Alarm' one, and that the technicians on duty can stay awake!

Thanks, G.B. I'm sure that we all share your apprehension about those missiles in silos, although hopefully recent world events have reduced the risk somewhat. Just the same, high pressure gas out of control could still produce a mini-mushroom over Adelaide, so your concern was not totally misplaced. Thanks again for the reminiscence.

Worthwhile tip

Finally, here's a tip that I picked up recently at a technical seminar. It concerns remote controls, and specifically the transformer that powers the remocon receiver when the set is in the standby mode.

The story is particularly about Mitsubishi sets, but probably applies equally to other brands with similar standby systems. The transformer is a small 7VA type that normally supplies 12 volts to the remocon receiver at a low current. This voltage is present while ever the set is in the Standby mode.

At switch on, the receiver closes a relay to connect the mains voltage to the main power supply. To do this, the small transformer has to deliver considerable current to activate the relay, and it gets very tired very quickly.

In order to relieve the load on the remocon transformer, a 14V supply is arranged to take over relay duty as soon as the line output stage becomes operative. A diode between the remocon 12V rail and the 14V supply effectively isolates the two sources once the set is running.

So, what happens if the 14V supply fails?

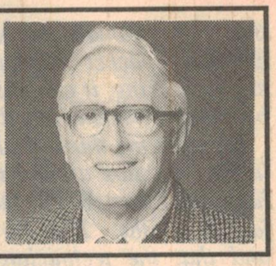
Well, the 7VA transformer has to carry the relay load to keep the set operating. And as this is more than the transformer is designed to do on a continuous basis, it eventually burns out.

The moral of the story is that if you ever have to replace a new or near-new remocon transformer, look at the 14V rail. If it's not there, you will be forever replacing transformers. Even better, check the rail when you replace the first transformer.

Well, that's it for this month. I don't know what I'll find for you next month, but you can be sure it will be interesting. ❖

SHORTWAVE LISTENING

by Arthur Cushen, MBE



Boom in Central Asia radio broadcasting

This month we highlight the changing radio position in the Central Asia area of the former USSR, with news of the developments in that region. Also highlighted is the 50th anniversary of the Voice of America, which was the subject of a special conference in Washington, attended by broadcasters, listeners, manufacturers and researchers.

To visit several of the new republics in Central Asia, and learn of their move into extended broadcasting services since they became republics, was one of the highlights for Martin Hadlow of Kuala Lumpur in a UNESCO-sponsored research visit.

Martin Hadlow is well versed to comment on the area, having been in Central Asia three times over a two-month period. His visit included travels through five countries: Tajikistan, Uzbekistan, Kyrgyzstan, Kazakhstan and Turkmenistan — enabling him to compile an overview of the current media situation.

Martin commented that the visit was fascinating. Imagine visiting Uzbekistan, and telling the Chairman of the State Radio and Television Company that one has QSL's from the English language transmissions of Radio Tashkent — and these were received while he was still in his teens! While driving out of Tashkent, he saw the massive antennas of Radio Tashkent, which incidentally, are now being used as relays by the BBC to provide a strong signal into India.

The switch from the old state-owned radio services to the new radio companies has given added emphasis to their value.

Foreign capital is being invested in several so that they can be used as relay bases, and time has been hired on various transmitters to give better coverage to the BBC, Adventist World Radio and other organisations in the Central Asian area. In Kazakhstan and Kyrgyzstan private radio stations are operating; while Radio Maximum and Radio Pyramid are the key operators in Alma-Ata and Kyrgyzstan. Both of these are urban based stations, but plan to move into a network in the future.

Of the countries that Martin Hadlow visited, Uzbekistan is the best known to shortwave listeners because of its three daily transmissions in English. It has a population of 22 million people, with about 2.1 million of these living in the capital city Tashkent, according to a UNESCO Media and Communications Overview.

In Uzbekistan, the Radio Broadcasting Company controls both television and radio services. It is funded by the Government and employs around 5000 people. The Company has its own studio facilities, but leases transmission facilities from the Ministry of Communications. The radio broadcasts programmes 18 hours a day in four major and several minor languages, while the international service using the slogan 'Radio Tashkent' broadcasts in 10 languages for overseas listeners.

Radio Tashkent has transmissions in English 0100 - 0130 UTC on 7325, 7335, 9740 and 11,975kHz; 1200 - 1230 and 1330 - 1400 on 7325, 9715, 15,460 and 17,815kHz. The BBC has leased time on Radio Tashkent for two daily broadcasts, 0045 - 0135 in Hindi and 0135 - 0200 in Urdu on 7325kHz; and 1410 - 1500 in Hindi and 1500 - 1545 in Urdu on 9725kHz.

Martin Hadlow is a radio listener of many years experience, and has worked in the media in NZ, Australia and Malaysia. He was recently appointed Regional Communication Adviser for Asia UNESCO. He has visited many parts of Asia, and is a regular contributor to the Asia-Pacific Broadcasting Union magazine.

Support for VNG

The Australian Time and Frequency Station VNG has received financial support from the National Standards Commission. For the past four years, the reassembling of the transmitters at Llandilo near Canberra, and funding of VNG has been from the Consortium of VNG users. Though there is now major fund-

The headquarters of the Voice of America in Washington, the site of a recent Conference to celebrate 50 years of VOA programming.

AROUND THE WORLD

BELGIUM: Using the new slogan, Radio Flanders International, Brussels is broadcasting to the Pacific in English at 0730 - 0800 on 11,695kHz, and to Europe on 5910 and 9905kHz. The address is the same as the old BRT — PO Box 26, 1000 Brussels, Belgium.

NEW ZEALAND: RNZI Wellington is now operating at 1650 - 1849 on 9675kHz; 1850 - 2137 on 15,120kHz; 2138 - 0400 on 17,770kHz; 0400 - 0658 on 15,120kH; 0659 - 1207 on 9700kHz and 1208 - 1649 on 9510kHz. The latter frequency is used only for special broadcasts, while the transmission on 17,770kHz has been shortened because of a fall-off in the signal. The broadcasts on Monday at 0430 and Thursday at 0830 include Mailbox and shortwave information every second week, with the alternative programme being Travel Pacific.

RUSSIA: Radio Nederland is using transmitters in Russia: Chita in East Asia in English 0030 - 0325 on 11,675kHz; and 0930 - 1125 on 9810kHz via a transmitter at Irkutsk, while a transmitter in Petropavlovsk on 7260kHz carries the same programme. Other language broadcasts, using transmitters in Russia and Uzbekistan, carry Radio Nederland programmes in Indonesian and Dutch, while there is also a special service for the Dutch Soldiers with the UN in Cambodia on Sundays from 0800 - 0925 on 15,210kHz via the Chita transmitter. Radio Nederland is keen to receive reception reports on the use of these Russian transmitters, and a special verification card is being issued. Reports should be sent to Radio Nederland, PO Box 222, Hilversum, Holland JG 1200.

Radio Moscow's World Service latest schedule indicates they have T-shirts, sweat-shirts, coffee mugs and hats for sale. Its schedule to Australia and New Zealand is extensive, but for our evening listening: 0600 - 0800 on 17,570, 17,655, 17,825 and 21,790kHz; 0800 - 1000 on 17,765 and 21,845kHz; and 1000 - 1100 on 9780, 11,675, 11,710 and 17,695kHz. These are only a few of the frequencies available.

UNITED STATES: Dallas, Texas transmitter KCBI which has been off the air for some months, is operating again on 15,375kHz, and its callsign could be changed because it no longer relays the local Dallas station. The address for reception reports is KCBI Shortwave, 22720 South East 410th St., Emamclaw, Washington 98002, USA. The transmissions are from 1400 - 0230 on 15,375kHz and from 0230 - 1400 on 9815kHz. Reception has been received at 0900 on 9815kHz when the programme was generally featuring Dr Gene Scott in his gospel broadcasts.

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ing, the VNG Consortium will continue in its role of answering queries and providing liaison between the users and the National Standards Commission.

The most recent improvements to VNG have been the talking clock and a new 2500kHz transmission. The talking clock was introduced last year, while the 2500kHz transmitter uses 1000W and a vertical antenna.

Transmission is continuous, and is intended primarily for the Sydney area where users have experienced difficulty receiving VNG Radio from the horizontal aerials. This frequency of 2500kHz was introduced in September last year. VNG is now transmitting on five frequencies; 2500, 5000, 8638, 12,984 and 16,000kHz.

According to Marion Leiba, Honorary Secretary of the VNG's User Consortium, the funding by the National Standards Commission is of tremendous assistance in the continuation of this excellent service. Now that the VNG transmitters are all located at Llandilo, the members of the Consortium are doing a tremendous amount of voluntary work to maintain the service. The address for information is: VNG Users Consortium, PO Box 1090, Canberra 2601, Australia.

VNG originally broadcast from Lyndhurst, Victoria using 4500, 7500 and 12,000kHz, and operating three transmitters with one on standby. With the move to Llandilo there was no backup facilities, but now a standby transmitter has been made available from surplus equipment of Radio Australia.

The station has been of great benefit to listeners in the South Pacific, who are able to observe propagation activity. The time on the talking clock is heard every minute, and the second pulses are the balance on the frequencies; while at 14, 29, 44 and 59 minutes past the hour, a complete spoken announcement is given on 2500, 5000 and 16,000kHz.

Positive thinking

A recent conference organised by the Voice of America in Washington, attended by a large cross section of the broadcasting industry, found a general agreement that more should be done to promote shortwave radio.

The broadcasters, manufacturers, researchers and the listeners were all convinced that some stations have the right format — particularly Africa No 1 in Gabon, which has built up its huge audience in West Africa. Its recipe of lots of music and short news bulletins has been the reason for its success; but one wonders what are the 5300 million people on the earth listening to?

The Deputy Director of the United States Information Agency told the Washington Conference "We remain committed to radio. Radio comes into the home as an invited guest, it is admitted or rejected by the turn of a dial. To be able to compete in an age of television images, no one knows better than the VOA that radio must be dynamic, attractive and intellectually stimulating."

"Radio has several advantages: simplicity, economy and portability. While two thirds of the world's citizens do not have access to any other electronic media source, most however can get hold of inexpensive shortwave radios. Radio can, and does, compete on its own merits with television and video cassettes. It is increasingly important to the Voice of America and the USA to keep up America's international broadcasting effort."

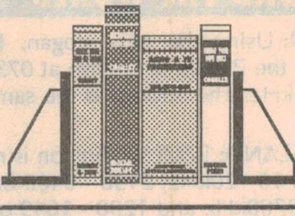
Looking at the receiver manufacturers, Lawrence Magne who is one of the world's leading reviewers of equipment pointed out that Sangean sold over half a million receivers in Europe each year, and the markets are unknown for sales in Africa and Asia. The quality of the new shortwave radios remains a sore point, and Lawrence Magne reflected "It is time some manufacturers did some proper market research. They do not know what is going on, but make the radios, ship them to countries and the money comes back."

"Sony, for an example, is an excellent company and for years has dominated the serious shortwave listener market. But now they are making radios which require computer wizardry to operate — completely the opposite of what we want. As broadcasters, we are looking for audience — not gadgeteers."

The Conference certainly showed that shortwave is here to stay, but that some dramatic selling of the programme contents, and researching the audience, is necessary to find out what the average shortwave listener wants to hear. ❖

This item was contributed by Arthur Cushen, 212 Earn St. Invercargill, New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 11 hours behind Australian Eastern Daylight Time and 13 hours behind NZ Daylight Time.

NEW BOOKS



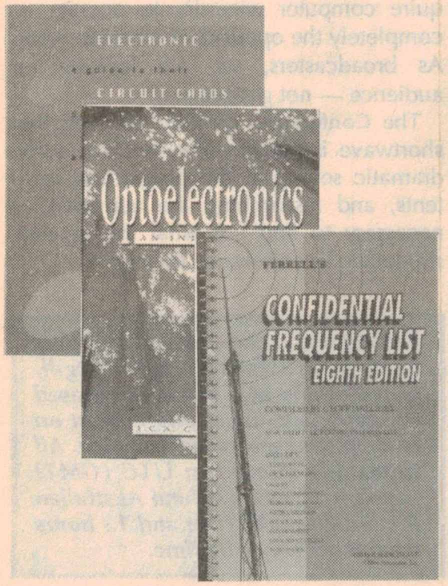
PCBs and SMT

ELECTRONIC CIRCUIT CARDS AND SURFACE MOUNT TECHNOLOGY, by Malcolm R. Haskard. Published by Prentice Hall, 1992. Soft cover, 235 x 170mm, 227 pages. ISBN 0-13-249988-6. Recommended retail price $44.95.

Printed circuits have made a huge impact on the electronics industry, especially with the advent of surface mount technology. Associate Professor Malcolm Haskard of the University of South Australia has written this book for technicians, service personnel and engineers alike. His aim is to present a total picture of the industry, covering from trade level right up to professional engineers.

The heads of the 11 chapters show the areas covered: Introduction to circuit cards; Printed circuit board technology; Soldering; Non-soldering joining methods; Electronic components; Stencil and screen printing; Assembly of circuit boards; Inspection and testing of cards; Production methods; Design of a circuit card; and Extensions of the technology. Two appendices give soldering practice boards and exercises.

The various processes are well explained, with suitable flow diagrams, photos and tables and graphs of relevant technical information. Health, safety and environmental issues are also discussed.



I can recommend the book for anyone seeking general background information for the whole area of circuit card design and production, as well as for specific technical data.

Our review copy came from Prentice Hall, of 7 Grosvenor Place, Brookvale 2100, while a second review copy came from Dick Smith Electronics. The book is available from DSE outlets (Cat.B-1620) and technical bookshops. (P.M.)

Optoelectronics primer

OPTOELECTRONICS, AN INTRODUCTION, by J.C.A. Chaimowicz. Published by Butterworth Heinemann, 1992. Soft covers, 235 x 155mm, 362 pages. ISBN 0-7506-0803-X. Recommended retail price $65.95.

The author has written this book for newcomers to lightwave technology, from the inquisitive general reader to the practising engineer (especially those with a strong electronic background). The impact of lightwave communications, laser machining, compact disc audio, fibre optic sensing, light guide image transmission and holography means that 'opto' devices have, or will impact on all areas of engineering.

Based on a series of lectures, the book gives a very thorough and technical treatment of optoelectronics. The 14 chapters cover: Introduction to light; How lenses work and light is guided; Working with photons: the P-N junction; Photometric and radiometric quantities; the LED light transmitter; the photodiode light receiver; fibre optics communication; fibreless communication; Lasers; Laser beam engineering; Optocouplers and isolators; Sensing with lasers; Holography, Fourier transforms and integrated optics; and electro-optics curiosities (e.g. optical levitation, colour changing, etc.). Further information is given in 13 appendices.

The book gives a very detailed and technical coverage of all the areas listed. There are numerous diagrams and illustrations to help explain the concepts mentioned. It contains a lot of interesting information on this rapidly developing area of engineering, but its detailed treatment *would* require keen reader interest.

The review copy came from Butterworth Heinemann, 271 Lane Cove Road, North Ryde 2113. It is available from technical bookshops. (P.M.)

Spectrum reference

FERRELL'S CONFIDENTIAL FREQUENCY LIST, Eighth Edition, compiled by Geoff Halligey. Published by Gilfer Associates, 1992. Spiral wire binding, 230 x 152mm, 544 pages. ISBN 0-914542-24-9. Australian price $32 delivered; price in New Zealand NZ$45 including GST and postage.

Interest in listening around the shortwave bands has resurged in recent years, presumably as a result of the availability of high quality communications receivers with stable and reliable digital synthesiser tuning, along with scanning and memory facilities. And this has triggered off publication of quite a few new 'spectrum reference' books, as well as updating of those that already existed.

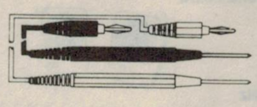
It seems the *Confidential Frequency List* has been around for quite a while, although I confess to not having been aware of this before. Its claim to fame is providing information on HF transmissions outside the traditional 'broadcasting' and 'amateur' bands, and the latest edition certainly seems to do this comprehensively. It now begins at 1613kHz (formerly only starting at 4MHz), and covers right up to 28MHz — covering all modes and 'utility' services including voice, RTTY, CW and fax used by aero, commercial, embassy, marine, meteorological, military, police and government users around the globe.

Included is a list by frequency of international callsigns and their allocation (401 pages), and with this edition a 'reverse' frequency listing is also given, listing by callsign and showing every known operating frequency (113 pages).

In short, then, it seems a very handy reference for the serious HF listener.

The review copy came from our shortwave contributor Arthur Cushen, who can supply the book by mail from his address at 212 Earn Street, Invercargill NZ. It's also available from Technical Books, at 299 Swanston Street, Melbourne. (J.R.) ❖

TEST LEADS FOR ALL PURPOSES



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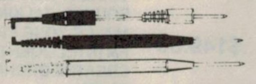

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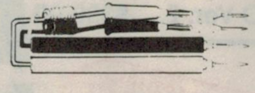

TLS-3 TEST LEAD SET
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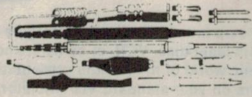

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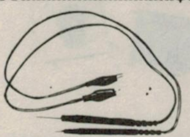

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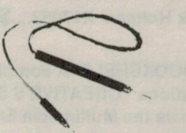

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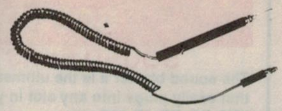

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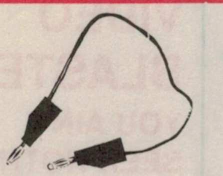

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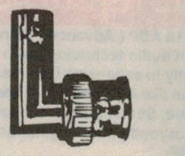

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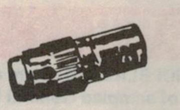

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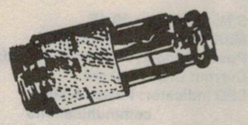

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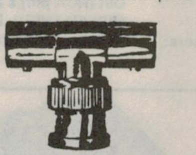

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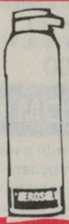

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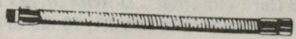

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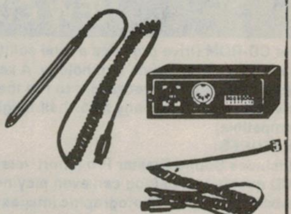

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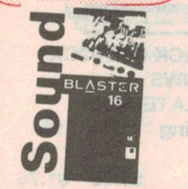

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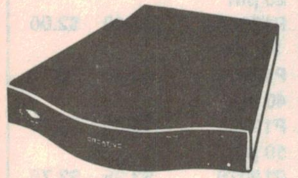

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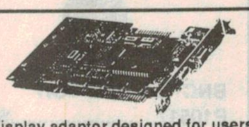

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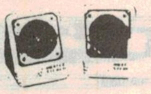

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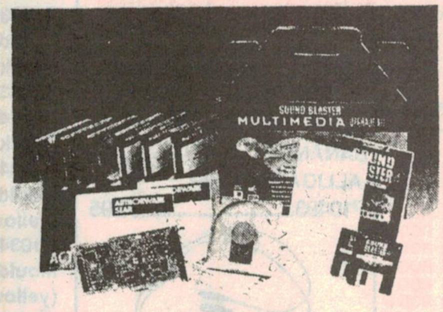

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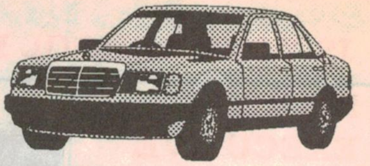


EFI, or Requiem for the Carburettor

The familiar carburettor will soon be celebrating its 200th anniversary — or will it be a wake? Thanks to the development of electronic fuel injection or 'EFI', the days of the carburettor are now very definitely numbered.

Where did the carburettor come from — who invented it? Well, way back in 1795, Robert Street achieved evaporation of coal-tar and turpentine in an 'atmospheric' engine — one without compression. This was the beginning of carburettor technology.

Then in 1824, a separate carburettor was invented by Samuel Morey and Erskine Hazard. These were known as *surface carburettors*, as they worked on the vapour fumes on the surface of fuel (see Fig.1). Of course benzene (petrol or gasoline) had not been invented yet; if it had, one back-fire would have seen the inventors or engine operators having to be scraped off the wall...

The present day carburettor, the 'spray jet', was invented by Willhelm Maybach in 1892. This laid out the design that would become the basis for all subsequent carburettors. In 1894, Maybach applied for a patent on the spray jet nozzle carburettor. Many other men around the world made very significant contributions to carburettor technology — too many to mention.

Birth of fuel injection

Between 1893 and 1901, the Deutz Company built 200 stationary engines with low-pressure fuel injection. The engines used patents by Eteve (French-1881) and Spiel (German-1893). This was the first use of fuel injection in a production engine.

The biggest boost for fuel injection, in my opinion, was when Wilbur and Orville Wright built a four-cylinder fuel injection engine for their aircraft flight in 1903. This was followed by the famous Antoinette fuel injected engine, which powered the Santos-Dumont aircraft in 1906. Then in 1937, Mercedes-Benz conquered the aircraft field with a 33.8-litre V12 fuel injected engine with an unheard-of starting horsepower of 1200hp. However, in the meantime, a carburettor had been invented that would allow an aircraft to fly upside down. Fuel injection for aircraft slowed down, until World War II. Of course the rest is history — the jet engine.

For quite a while, it seems the only people interested in high performance were the racing industry and some individual fuel injection buffs. But by 1952, almost all Indy (Indianapolis 500) race cars were fuel injected. Most used the Hilborn indirect injection system, which sprays atomised fuel into the intake valve port, rather than directly into the combustion chamber.

The EFI mandate

The beginning of the end, for the carburettor, came not as a result of technological evolution, but a change in the law. This came in America in 1977, when California took a serious interest in air pollution and set new emission standards for vehicles.

This in itself didn't mark the end of the carburettor, though. Not yet, because Detroit still had a few tricks up their

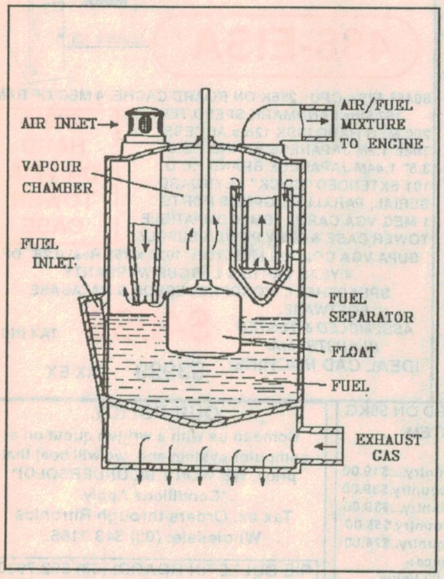


Fig.1: An early 'surface' carburettor.

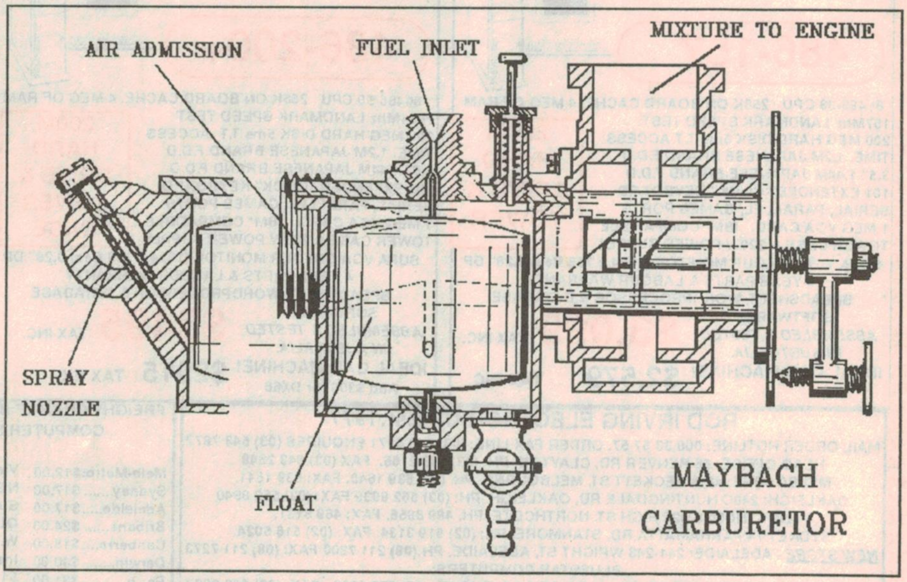


Fig.2: The present day 'spray' carburettor was developed by Maybach in 1892.

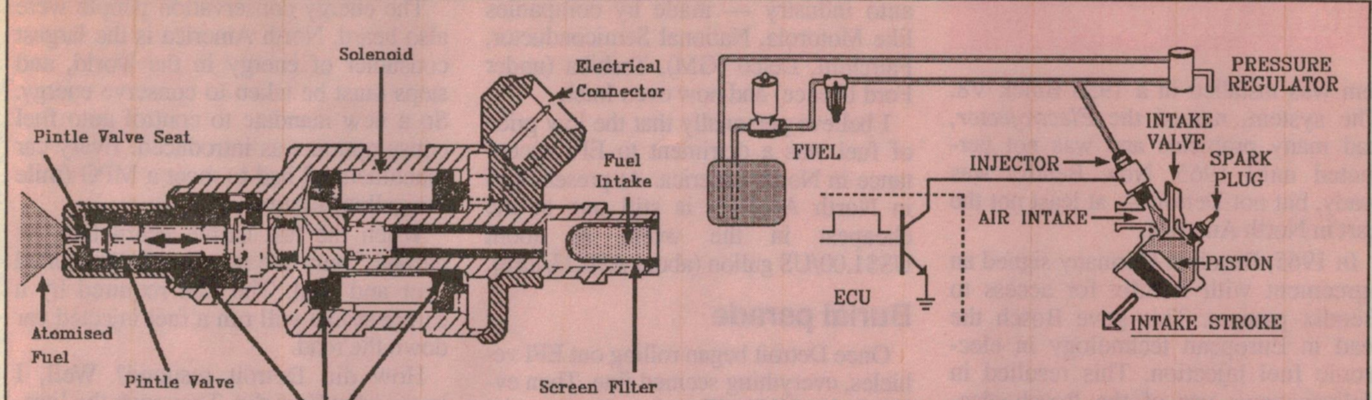


Fig.3: What's inside a fuel injector (left), and how it works. The ECU pulses the solenoid-operated valve on and off, to meter fuel flow into each cylinder.

sleeves. (Note: I use the term 'Detroit' as a handy label to represent all auto manufacturers worldwide, not just those in Michigan, USA.)

Detroit simply trashed the old carbie, and added one with motorised control. The controller was an on-board computer, known as the ECU (Electronic Control Unit). It controlled a metering valve that was simply turned on or off to control fuel to the main jet. I cannot find the words to express what a fiasco they were, in a family magazine like *EA*.

The first systems maintained many non-ECU controlled devices that effected the overall operations, like intake air and carburettor temperature — even emission controls. The later units were much better, but required a lot of maintenance and attention to detail. One significant thing *had* been accomplished, though: the use and acceptance of the ECU for engine management.

Another mandate

In the meantime, the sun continued to set in the West as far as the carburettor was concerned. The California Environment Control, known as CAFE, set further new emission standards.

The control agency that enforces these mandates is the California Automotive Regulation Board, usually known as — are you ready for this? — CARB. It seems rather ironic that the demise of the carburettor was presided over by an agency called CARB, don't you think?

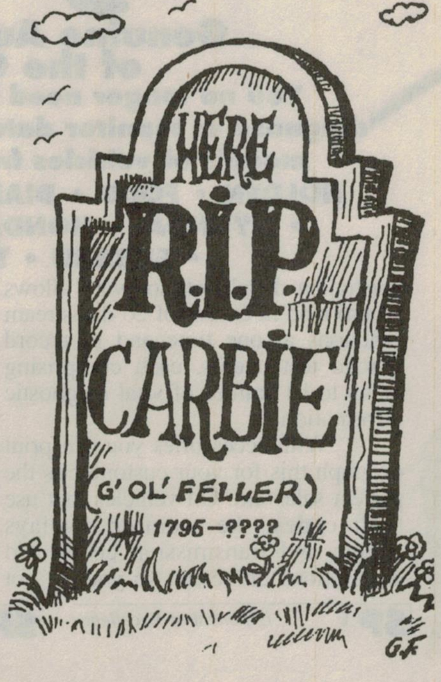
Now in Australia, the natural reaction is to say 'So what — that has nothing to do with us, we're too far away'. But if you've been in this business for as long as I have, you come to only one conclusion: the way California goes, so goes the world.

California leads the world in air pollution research. And Detroit listens, as there are over 26 million people in California (what a market!). Detroit also pays, with grants to California's institutions of higher learning. All the main universities have an engineering department for sensors and actuators, most working on grants from state, federal and Detroit funding.

The US Federal Government's EPA (Environmental Protection Agency) has conceded to CAFE for air pollution standards, and all US states are now mandating new laws on emission standards. This lead is being followed by most of Western Europe.

EFI reborn

California has raised the emission standards so high that carburettors and even mechanical fuel injection systems cannot comply. One very important item also is that leaded fuel is now 'outlawed'. Why we still use it in Australia is asinine, in my opinion. Lead is a known killer and we know it. Cars run fine on unleaded fuel. It is a fact that the biggest single cause of air pollution is the motor vehicle.



Of course we know what it takes: more deaths and destruction of our environment. Then the politicians get excited and call for a few million-dollar studies and when these are finished they'll most likely be shelved.

The technology is already in place; it is up to governments to follow California's lead and mandate immediate laws for clean air, without costly 'studies'. Mexico City has decided that no vehicular traffic will be allowed in the city on weekends unless it is a medical emergency, according to a recent news item (they only have leaded petrol in Mexico).

Goodbye carbie

The quickest way for Detroit to comply with the tightening emission laws was to pitch the carbie and install an injector. That is exactly what they did.

Some ECU's already fitted would work with injectors. This became the CFI (Central Fuel Injection) system, which gave Detroit breathing room to manufacture better systems. It still had the same technical problems of the carbie, like manifold wetting, but it was 'so much better'.

Working under the bonnet became enjoyable again — and simple. Bendix had the products, Detroit just needed tooling time. What is amazing is that all the technology was available before 1970. Since then only refinement of sensors and actuators, etc., has transpired. This can be attributed to new technology in manufacturing.

Serious study of *electronic* fuel injection (EFI) is credited to Robert Sutton, an engineer for Bendix, in 1951. A sys-

tem was installed in a 1953 Buick V8. The system, named the *Electrojector*, had many problems and was not perfected until 1965. Now Bendix was ready, but not Detroit — at least not the part in North America.

In 1965, Bosch in Germany signed an agreement with Bendix for access to Bendix patents. This gave Bosch the lead in European technology in electronic fuel injection. This resulted in Volkswagen's use of the Bosch electronic fuel injection system, which later became known as *D-Jetronics*, in 1968. Then in 1969, Bendix and Bosch jointly signed a licence agreement with Nippondenso. Now Japan would have western technology in electronic fuel injection; all the elements were in place.

Technology gap

Bendix's early problems were the expensive electronics required. The racing industry used their systems, and so did some luxury cars like Cadillac and Buick. You could say that Bendix was waiting for the electronics industry to catch-up. They finally did, by manufacturing dedicated microprocessors for the auto industry — made by companies like Motorola, National Semiconductor, Fairchild, Delco (GM), Toshiba (under Ford licence) and now even Intel.

I believe personally that the low price of fuel was a detriment to EFI acceptance in North America. At present fuel in North America is still one of the cheapest in the world at about US$1.00/US gallon (about A$0.33/litre).

Burial parade

Once Detroit began rolling out EFI vehicles, everything seemed fine. Then everyone started getting into the act. All the governmental agencies that ever existed wanted their say. They were coming up with so many restrictions on the automobile that I was about to purchase a horse.

One that really amused me came from the vehicle safety lobby. This was that all vehicles be fitted with an indicator that showed excessive brake pad or lining wear. I personally thought this was a good idea, and it was fitted on some vehicles. But the safety people then went a step further, to the ridiculous. They wanted this condition to produce a shutdown of the vehicle. Have you ever stalled your car, when entering a main road, in front of oncoming traffic?

The energy conservation people were also heard. North America is the largest consumer of energy in the world, and steps must be taken to conserve energy. So a new mandate to control auto fuel consumption was introduced. Every car manufactured had to meet a MPG (mile per gallon) figure.

When the last carbie heard this, he gasped "bury me now" and then rolled over and died. The fuel required by a carbie at idle will run a fuel injected car down the road.

How did Detroit respond? Well, I know what Ford did. They took the 'gas-guzzler' Lincoln Continental, and shaved a few kilo's off; then they sleeved the famous Cleveland 351 engine down to five litres, fitted EFI and an automatic overdrive transmission. The highway fuel consumption went from 12mpg (5km/litre) to at least 25mpg (11km/l). A friend of mine claimed 28mpg (12km/l).

EFI: it's simple!

The basic concept of electronic fuel injection amounts to only one thing: turning the injectors ON and OFF. To accomplish this we use a microprocessor, provided with all the information and instructions (software) to tell the in-

 READER INFO NO. 14

jector when to turn ON, how long to stay ON and when to turn OFF — under all conditions. (See Fig.3).

Now isn't that simple? Why do some people try to make it difficult? It's new technology for engine management, but I have seen computer controlled devices that are far more complex. And each injector only has one moving part. Of course the processor does more than just control the injectors...

Talking about EFI processors, these have evolved quite a long way in terms of both hardware and software. As technology advanced, the ECU's became smaller and the components very reliable. The biggest improvement though, has been in software.

I have always said, 'Programmers will run the world'. Some of the first ECU programs were pathetic, even tragic. Of course the programmers were writing to meet a Detriot specification. The biggest mistake was made in 'Default Mode', otherwise known as 'Limp Mode'. This allows a faulty system to run until a repair can be made. And some early systems just stopped — they had no Limp Mode at all (an example: L-Jetronics).

Many other cars with Limp Mode would stop if a critical sensor failed. The story goes that the proverbial 'little old lady' sued Detroit when her car stopped in the middle of nowhere. In most cases it just took a new programme to rectify the problem. The latest families of ECU's now have several back-up modes, to avoid complete shut-down.

Not everyone in Detroit made the same mistake. Some systems allow almost complete sensor failure and will still run, albeit very poorly. On the other hand, some systems are programmed so well in the default mode, that performance actually improves! This is because the system is running too rich.

People used to tell me that their car was suddenly running 'great' — they just wanted me to turn OFF their 'Check Engine' lamp (which comes on in Limp Mode). It was often very hard to convince them that the system was in Limp Mode, that there was a system fault and they were burning excess fuel.

One customer stated that the car was running better than when he bought it — couldn't I just do something about the excess fuel consumption?

Maintaining EFI

Those of us who've been fixing 'electronic' cars for a while did not have to be kicked in the head by a mule, to realise the importance of preventive maintenance — which means *routine* maintenance.

Here's the scenario: A new car is purchased and driven annually 12,000 clicks with no maintenance. Within three to five years, it runs very poorly. The owner takes it to a repair facility. The shop does a complete service and the car runs fine. But unfortunately, some systems will self-destruct for lack of maintenance. Especially AFC (air flow control), which is fitted on many cars. It just takes a few backfires...

Mechanics 'in the know' have generated a new industry: 'Car Care'. At present there is a Car Care War in Australia, which gives me a feeling of *deja vu* as I saw the same thing happen earlier in North America. Everyone except the local chemist jumped in, even major department stores.

I know many motor shops that no longer do major repair work; they're making too much money during routine service. One of my most frequent sayings when I'm giving seminars is 'If everyone properly self-maintained their own car, 50% of the shops would close'. Of course human nature being as it is, this will never happen.

Epilog

The 'good old carbie' is dead and gone, but his memory lingers on. He served us well, as we remember, but he won't be around for many more Decembers. He guzzled fuel like it was free, and a US government mandate made him flee. Let's welcome EFI, the new kid on the block...

That's all for this time. If you have any questions on automotive electronics, write to *EA* attention 'Major Al' and I'll be happy to respond. By the way, I am also available for lectures to associations or clubs. Write to me on your letterhead via my mail address: PO Box 477, Double Bay 2028. ❖

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LED VU Meter

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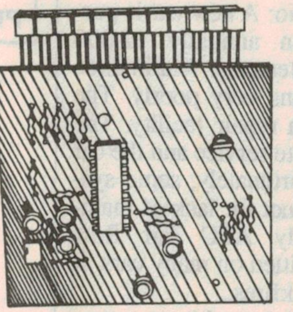

SILICON CHIP Feb. '93

NEW! Two-channel Camcorder Mixer

One of the things that decides whether a home video movie is a bore or a block-buster is the soundtrack. This inexpensive kit makes it easy to give your videos that Hollywood feel, complete with music and sound-effects! 9V battery-powered, the kit comes in full-form with PCB, case, front panel label, hardware, battery holder and all components, including IC socket.
* Battery not included.
K-5408

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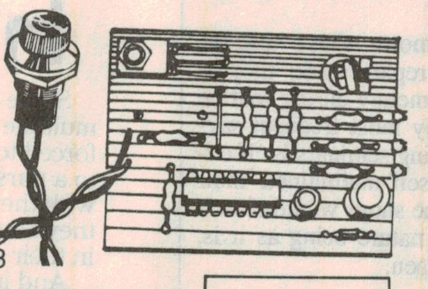
SILICON CHIP March '93

Low Fuel Indicator

If you've ever run out of fuel in your car, you'll see the value of this low-cost kit. It lights a 12V warning lamp when the fuel drops below a pre-determined level. Harder to ignore than your standard gauge, the light could save you a great deal of inconvenience and embarrassment. Comes with PCB, case, 12V panel mount lamp and all necessary components, including auto connectors for easy installation
Cat K-4210

$14.95



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K-7604

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EA April '93

Coming Soon!

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With features usually only found in speaker systems costing thousands of dollars, this crossover improves the performance of your system by overcoming the limitations of passive systems. By preceding the power amplifier, this active crossover kit gives ideal high-impedance loads, less discrepancies in speaker driver efficiency and less resistance between the voice coil and amplifier. Comes as a short-form kit with PCB and all components.
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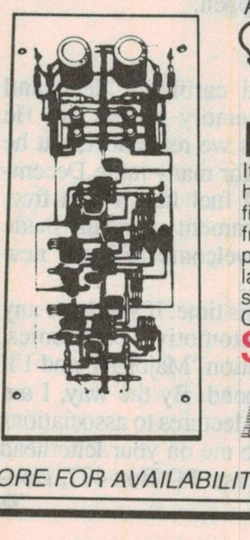
$34.95

EA April '92



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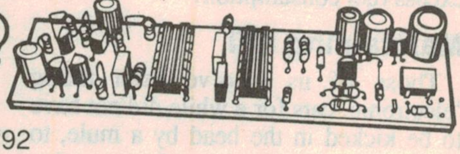

SILICON CHIP Dec. '92

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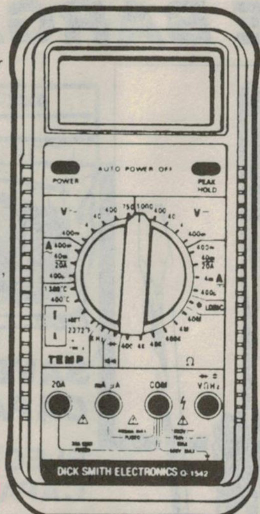

A rugged meter that's great for both field and workshop use, it's shock, water and dust resistant, featuring rubber o-ring gaskets on its rotary switch, input jacks and case. Supplied with a thermocouple probe for temperature measurement from -40°C to 260°C, the meter features most standard ranges plus:

* Continuity
* Diode Test
* Logic Test
* Frequency (Auto-ranging)
* Temperature

Cat Q-1542 **$179**

NEW!

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6.5MHz - Single Trace

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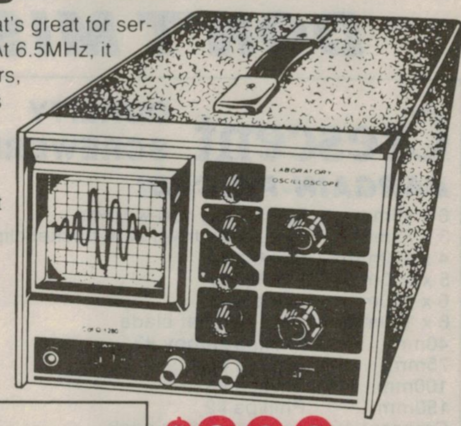
Cat Q-1280

Save $50



Specifications:
Vertical bandwidth: DC to 6.5MHz (-3dB)
Attenuator: 1/1, 1/10, 1/100 and ground
Horizontal sensitivity: 250mV/div or more
Timebase: 10Hz to 100kHz
Sync: External or internal
Input Impedance: 1 Meg/35pF

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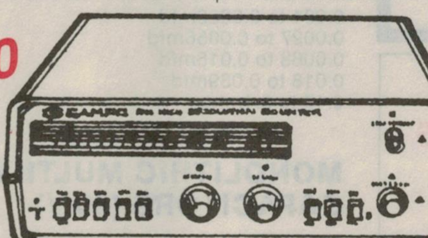

	Channel A:	Channel B
Freq. Range:	0.1Hz to 80MHz	50MHz to 1GHz
Sensitivity:	15mV to 50MHz 25mV to 80MHz	20mV to 650MHz 55mV to 1GHz
Coupling:	AC/DC	AC only
Max. Input:	3VRMS	3VRMS
Input Imped:	1Mohm/40pF	50ohms
Accuracy:	50PPM	50PPM
Trig. Mode:	Auto or manual	
Period Range:	10ns to 10 seconds	
Gate Time:	Variable from 60ms to 10s (or 1 period of input signal, whichever is longer.)	

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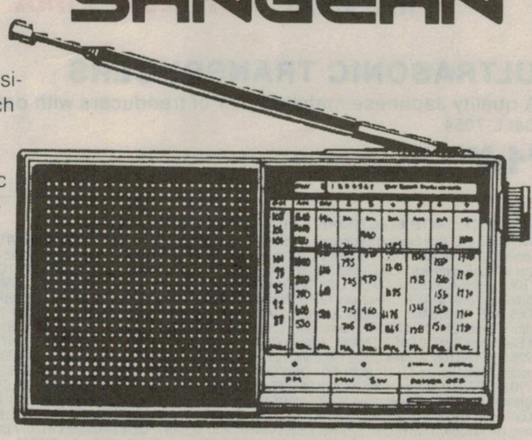

Specifications:

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	MW 530-1605 KHz	SW5 (13.55-13.85 MHz)
	SW1 (5.90-6.20 MHz)	SW6 (15.10-15.60 MHz)
	SW2 (7.05-7.40 MHz)	SW7 (17.50-17.90 MHz)
	SW3 (9.50-9.90 MHz)	

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5 x 100mm	Flat blade	T-6306	**$4.95**
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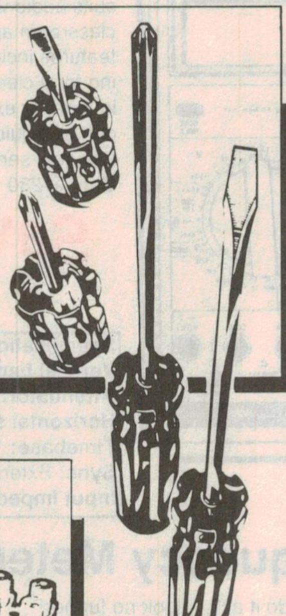

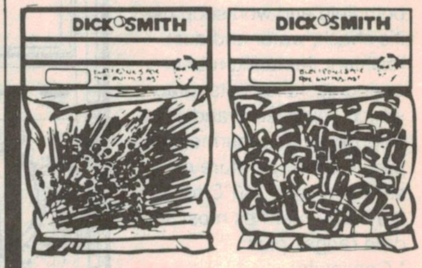

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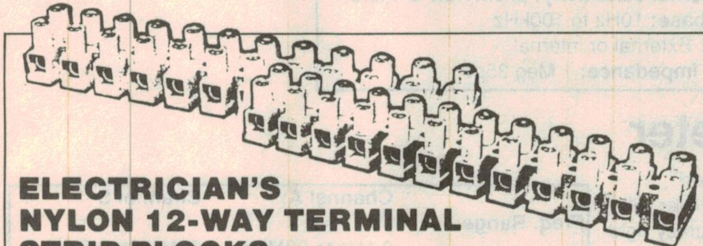

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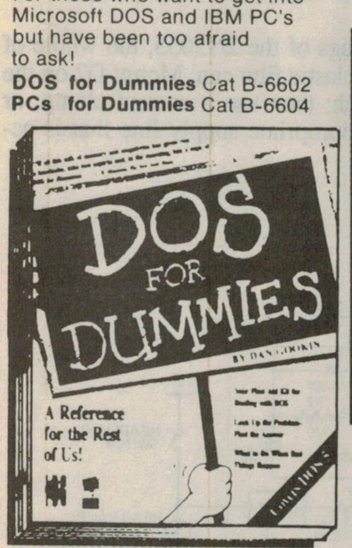

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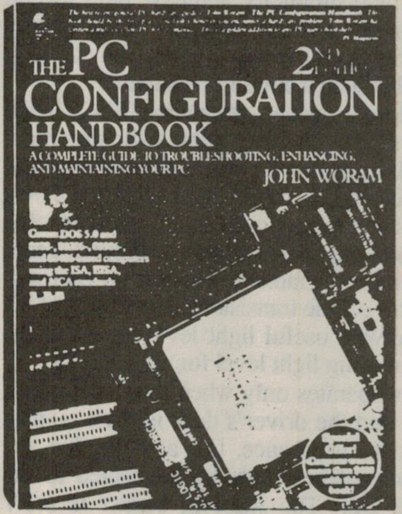

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Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

Car light extender and headlight reminder

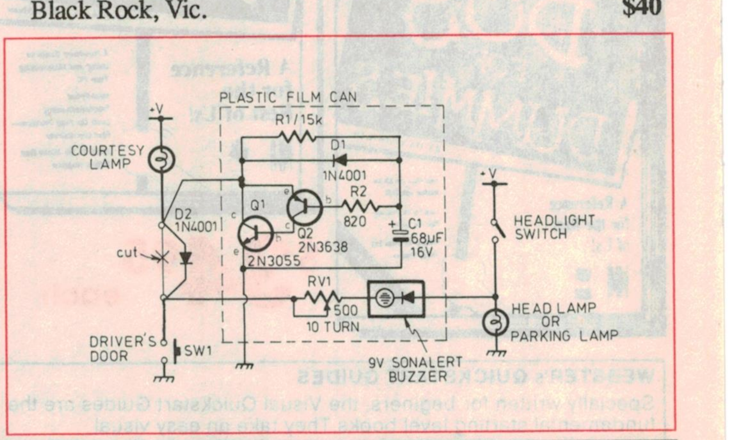
This circuit is an amalgamation of ideas published in *ETI*. I like it for its functionality and simplicity, and have built several over the years. This latest one was prompted by a flat battery after leaving on the headlights on my new Barina. Why oh why can't the manufacturer offer such a circuit as standard?

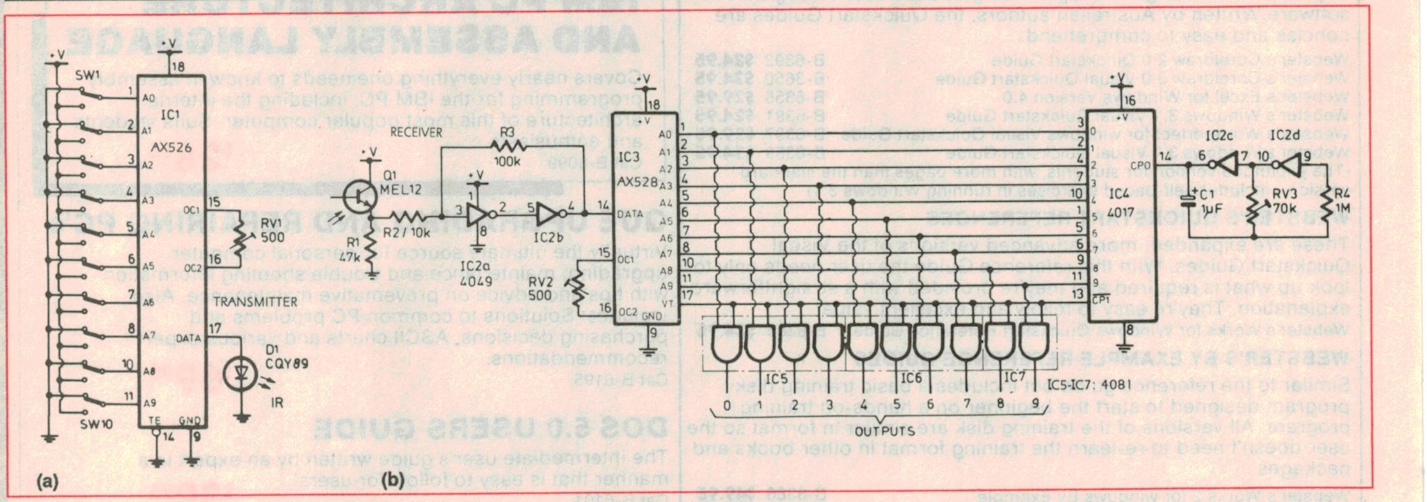
When the driver's car door is opened, the switch (SW1) in the door jamb closes and earths the courtesy light, switching it on. Before this switch closed, capacitor C1 was already charged to the supply voltage. Once closed, SW1 rapidly discharges C1 via diode D1. As soon as the car door is closed again, transistors Q2 and Q1 turn on, and connect the courtesy lamp to ground, keeping it switched on. Capacitor C1 gradually charges up via resistor R1, and eventually turns off the transistors. The values of R1 and C1 were chosen to give a useful light level for about 5s, followed by a further decreasing light level for a further 8s.

The headlight reminder operates only when the headlight or parking lights are left on and the driver's door is open — passengers may leave without disturbance. (To achieve this, the wiring to the other door switches must be connected to the anode of isolating diode D2.) The warning buzzer is a 9V Sonalert which has an inbuilt diode (needed here to prevent a continuously sounding buzzer). Adjust the 500 ohm preset to give a comfortable screech.

With some pruning of the lugs of the 2N3055, the whole of the circuit can be fitted into a plastic film can. Mount D2 on the tail of the driver's door switch; then use a current clamp, or trace the wiring, to find an appropriate supply line that is activated by the headlight switch.

Peter Manins,
Black Rock, Vic. **$40**





IR remote control

This circuit is designed to give a 10-channel infrared remote control. The transmitter consists of 10 SPDT switches, each of which causes IC1 (AX526) to transmit a different code via the infrared diode D1 (CQY89).

This transmitted code is received by the photo Darlington transistor Q1 (MEL12), where it is conditioned by IC2a and IC2b, part of the hex inverting buffer 4049, to become the input of IC3 (AX628), the code receiver.

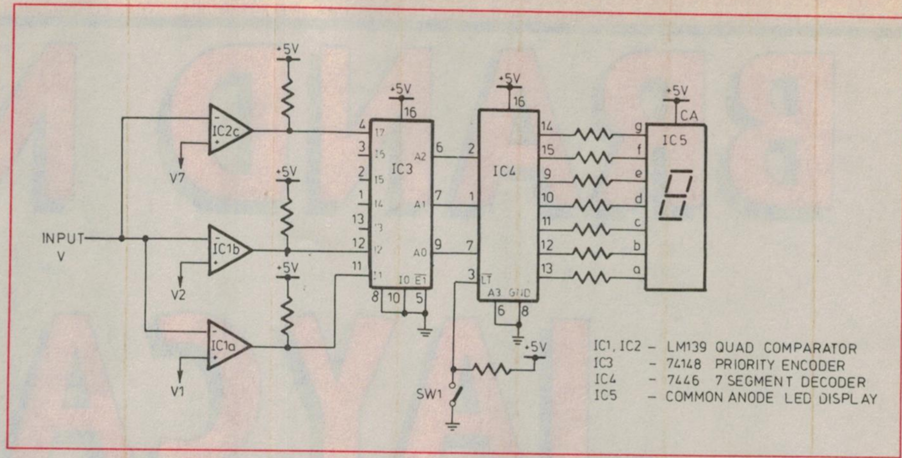
The second pair of gates of the buffer chip, IC2c and IC2d form an astable oscillator which clocks the 5-stage counter IC4 (4017) at approximately 10Hz. This causes IC4 to cycle through its routine, sending each of its 10 outputs high in turn.

When a code is received by IC3, and the corresponding line from IC4 is also high, the valid transmission line (VT) at pin 17 of IC3 goes high and disables IC4. The individual data lines and VT are ANDed on IC5-IC7 (4081), so that the correct output line goes high for as long as the transmitted code is being received.

A piece of exposed slide film should be used over the sensor Q4 to allow infrared only to pass through. The two variable resistors RV1 and RV2 should be set at the same resistance as they control the transmission of the code. Finally, two of the data lines, A10 and A11, are unused. They can be wired to provide a different code if two remotes are used together.

Chris Wheeler,
The Channon, NSW **$45**

Level indicator



A level indicator is easy to make using a priority encoder and a 7-segment display, as shown in the diagram. The 8-input priority encoder IC3 (74148) accepts data from eight active-low inputs and provides a binary representation on the three active-low outputs.

If two or more inputs are simultaneously active, the input with the highest priority is represented on the output, I7 having the highest priority.

The input voltage to the circuit (from some suitable sensor) corresponds to the level to be measured. This voltage is fed to the seven comparators in IC1 and IC2 (LM139) which give a logic low at their outputs when the input voltage is greater than their various reference voltages, V_1-V_7. These reference voltages are set with their values progressively increasing from V_1-V_7.

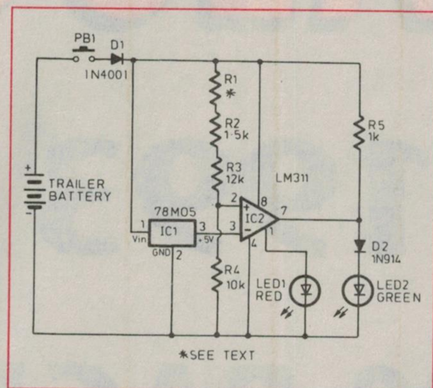
The priority encoder outputs a binary-coded number for the highest voltage, which is decoded by IC4, a BCD to 7-segment decoder (7446).

Its active-low drivers display this number on the common anode LED display IC5. For example, when the input is less than V_1, '0' is displayed. Then for continually increasing voltages, '1' to '7' are displayed in turn. Pressing switch SW1 checks that all segments on the display are working.

If you wish to use discrete LEDs rather than the 7-segment display, then a BCD-to-decimal decoder can be used instead of the 7446 for IC4.

S. Murugesan,
Campsie, NSW **$40**

Battery checker



Under the Queensland Traffic Act certain trailers are required to be fitted with electric brakes, incorporating a battery operated system which will automatically apply the brakes if the trailer comes away from the towing vehicle. The trailer needs to be fitted with its own 6Ah battery. As trailers are used on an irregular basis, a simple means of determining whether the battery is OK or not is necessary.

The circuit works on the principle that the output of voltage comparator IC2 (LM311) is either open or closed circuit, depending on whether the voltage applied to pin 2 is above or below the reference voltage at pin 3.

My unit uses IC1, a cheap 5V regulator (78M05), to give a more accurate reference voltage than a zener diode for pin 3; and has a resistor value of zero for R1 to produce 5V at pin 2 when the battery voltage is 12.4V.

If the battery voltage is above 12.4V, the output at pin 7 goes high, and current flows through green LED2. If the voltage is below the reference, the output is shorted to pin 1, turning on red LED1. This produces a constant voltage drop across LED1 of about 1.7V, and since LED1 is now in parallel with D2 plus LED2, there is insufficient voltage to keep green LED2 glowing. Diode D2 gives a more distinctive change-over point — without it, both LEDs remain on over a greater range of voltage.

The battery voltage (protected against reverse polarity by diode D1) is fed to the non-inverting input of IC2 via a voltage divider consisting of R1+R2+R3/R4, with R1 having a range from 0 - 300 ohms for a change-over voltage from 12.4-12.55V (100 ohms per 0.05V step). Since increasing the value of R1 increases the voltage for the change-over from red to green, to reference a voltage <12.4V you would have to reduce the value of R2+R3. When my unit was set to show red at 12.4V (R1 = 0), it changed to red and green at 12.41V, then to green only at 12.42V.

The main advantage of this circuit is that it is permanently in position and only needs a press of pushbutton PB1 to determine the battery status. It was built on a small piece of veroboard mounted on the terminals of the momentary pushbutton PB1. The switch was screwed to a metal bracket with the two LEDs protruding through adjacent holes. The unit was cheap to construct, easy to adjust, and has proved to be robust and reliable.

Reg Hoare,
North Rockhampton, Qld **$40**

NOTES & ERRATA

There is an error in the schematic diagram for Peter Parker's 'Receiver Modules', published in this column in the January 1993 issue.

Pin 7 of IC1 should be connected directly to the wiper of RV1 (not via C4, as shown). The bypass capacitor C4 should connect pin 7 to ground, that is, be drawn between the wiper and the left hand end of trimpot RV1.

DREAMED UP A GREAT IDEA?

If you have developed an interesting circuit or design idea, like those we publish in this column, why not send us the details? As you can see, we pay for those we publish — not a fortune, but surely enough to pay for the effort of drawing out your circuit, jotting down some brief notes and sending the lot with your name and address, to Jim Rowe at -

Electronics Australia,
PO Box 199,
Alexandria, NSW 2015

Construction Project:

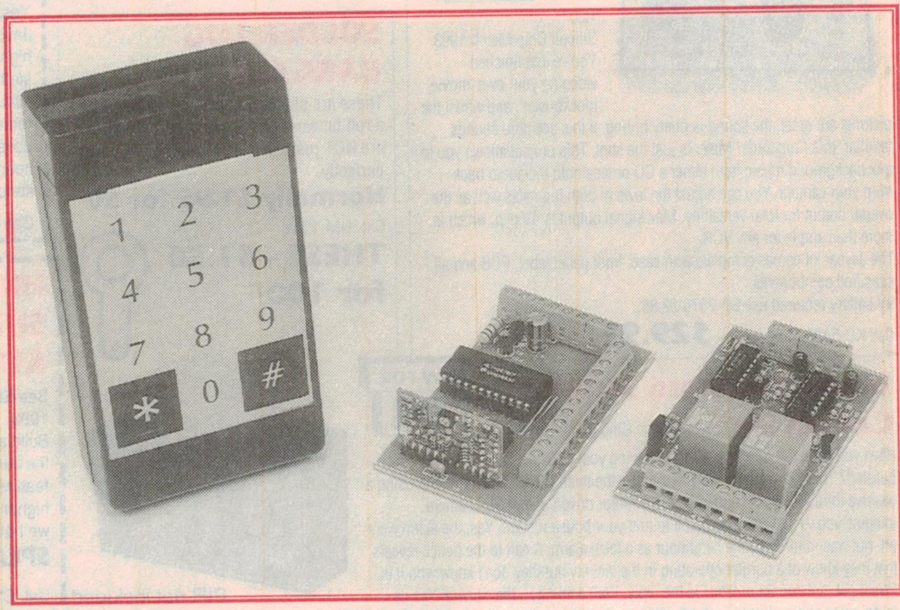
A 12-channel UHF Remote Control

This multi-purpose UHF remote control system has it all. It features a neat, keypad style handheld transmitter locked with a SAW resonator, a pre-built receiver module and separate relay driver boards — giving a modular construction so you can adapt it to any need.

by PETER PHILLIPS

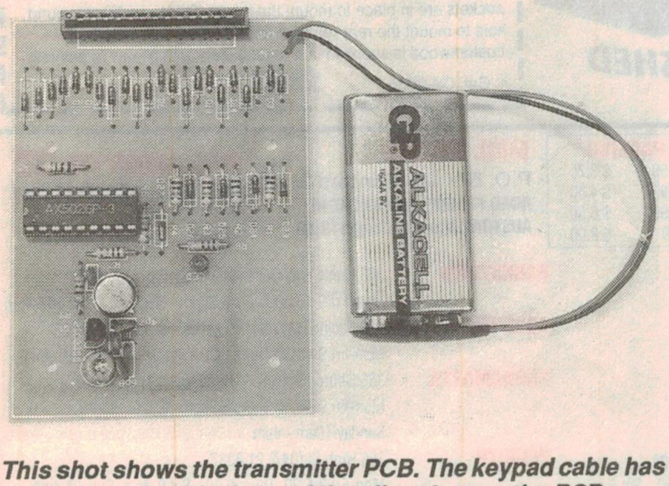
Remote control systems are always popular with constructors, and many readers will probably remember (or perhaps have built) the 16-channel UHF remote control system presented over a number of issues, commencing in November 1988. This system was developed by Oatley Electronics and used the technology available at the time. But since then, technology has changed and this latest version, also developed by Oatley Electronics takes full advantage of the changes.

Perhaps the three most obvious differences are the keypad style transmitter handpiece, the use of a SAW resonator to lock the transmitter on frequency and the surface mount UHF receiver module. But there are other improvements too, which collectively make this a much simpler project to build. For instance, to adjust the transmitter for maximum range, all you do is adjust a trimmer capacitor until a LED is at maximum brightness.

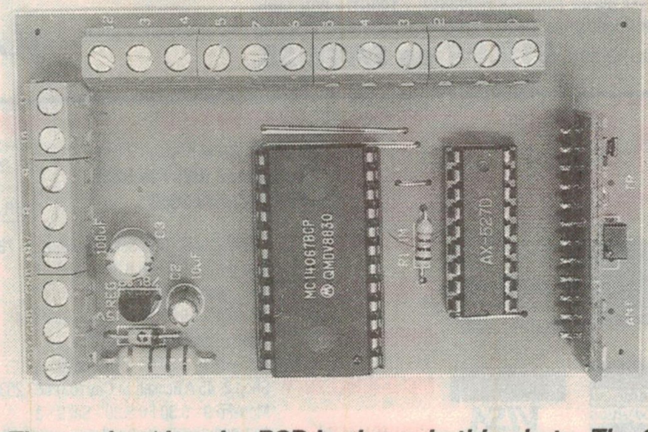


The receiver module is a pre-built unit, using surface mount construction. It simply solders directly to the receiver/decoder board and requires no adjustments.

A complete system has three sections: the transmitter, the receiver/decoder and one or more relay driver boards. The kit for the project includes professional



This shot shows the transmitter PCB. The keypad cable has to be formed so the keypad lies directly over the PCB.



The receiver/decoder PCB is shown in this photo. The 8V regulator on this board supplies power to the relay board.

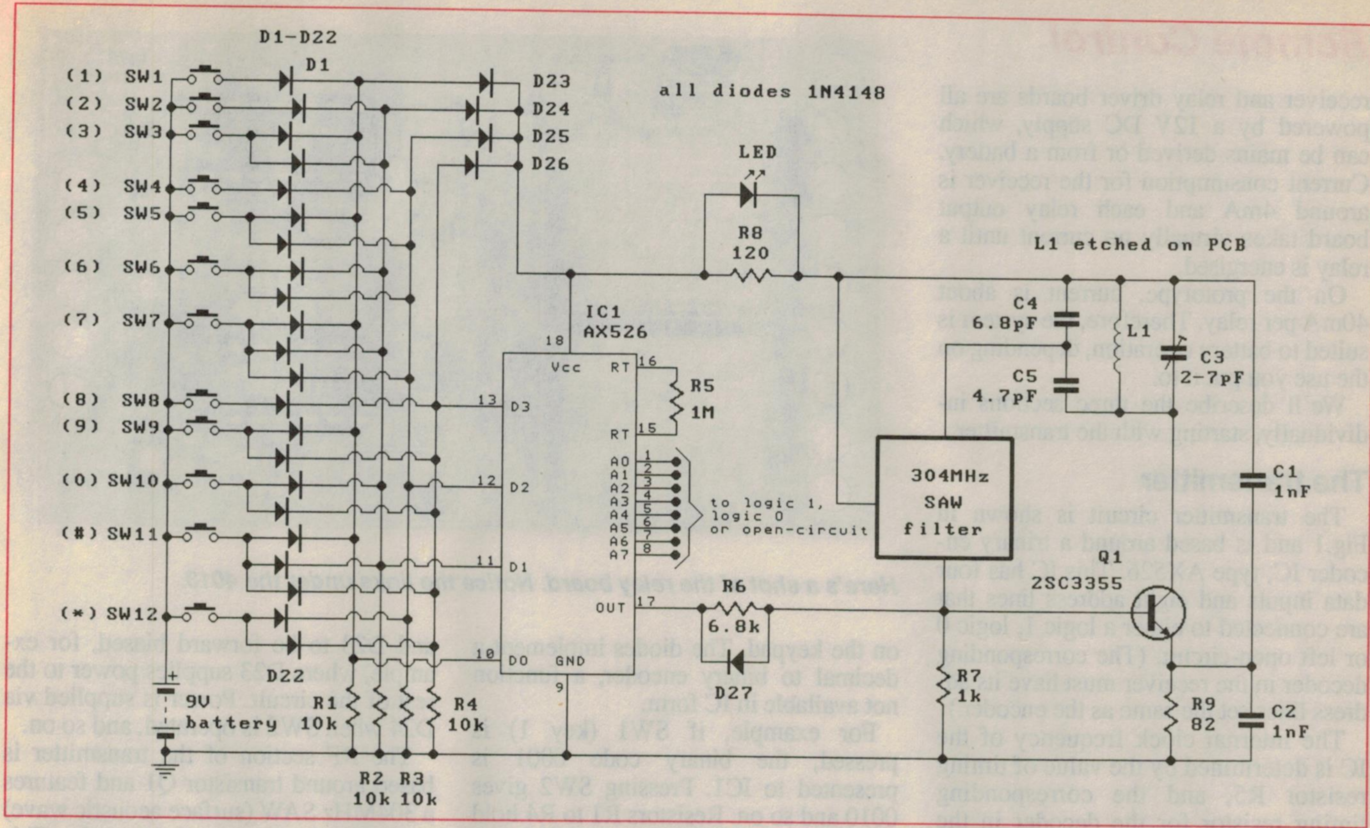


Fig.1: The transmitter uses a trinary encoder, which produces a digital output depending on the key being pressed. This output switches the 304MHz oscillator around Q1. The SAW filter ensures a stable operating frequency.

quality screen-printed PCB's for each of the modules. The relay driver board has two channels, with a relay for each output. The receiver section has the decoding logic and the receiver module. Although titled '12-channel', the unit is capable of 16 channels, and the decoder has 16 outputs. However, because the transmitter keyboard has 12 keys, the system is called 12-channel. But as you'll see when we describe the circuit, it's possible to add the extra four channels to the transmitter if you want to.

Because of the modular construction, the possible arrangements are virtually unlimited. For instance, you can have a single receiver module operating six relay output boards. Or you might want to use two or more receivers, connected to one or more relay boards. This would let you place each receiver/relay section to suit the application.

Individual relays can be set to either toggle on and off with each key press, or to hold on only while the key is being pressed. Each relay board also has an indicator output, which can be configured in various ways to let you know the status of a particular relay.

The transmitter has a range up to 200 metres and can be handheld or fixed to a wall. Because it's battery powered, there's no external wiring required. The

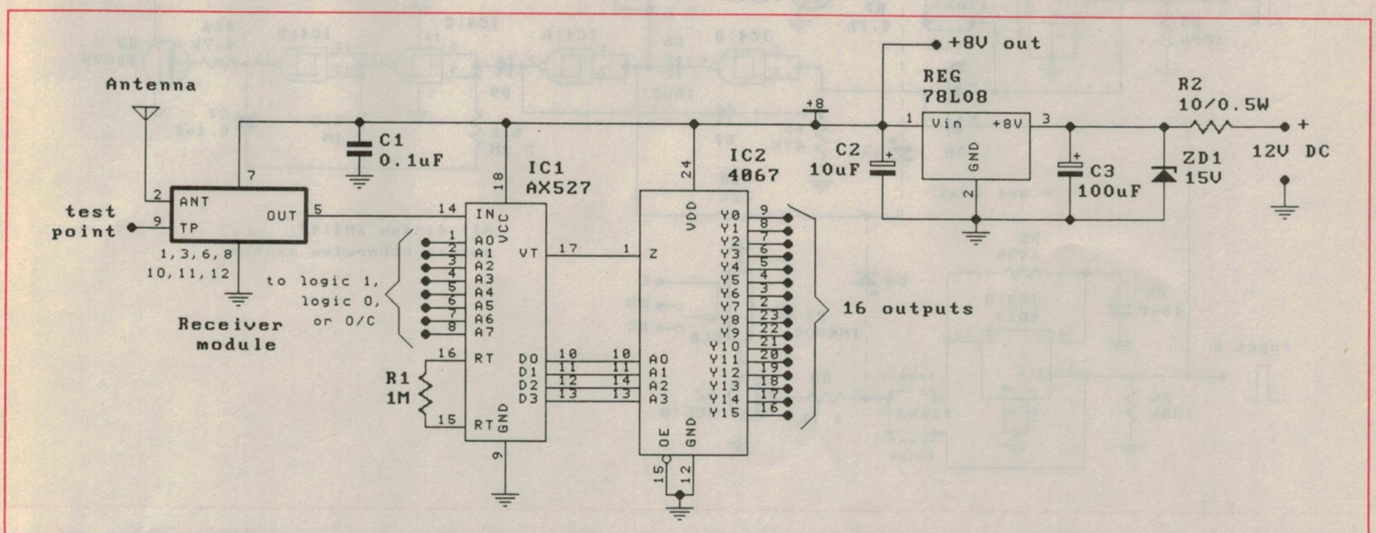
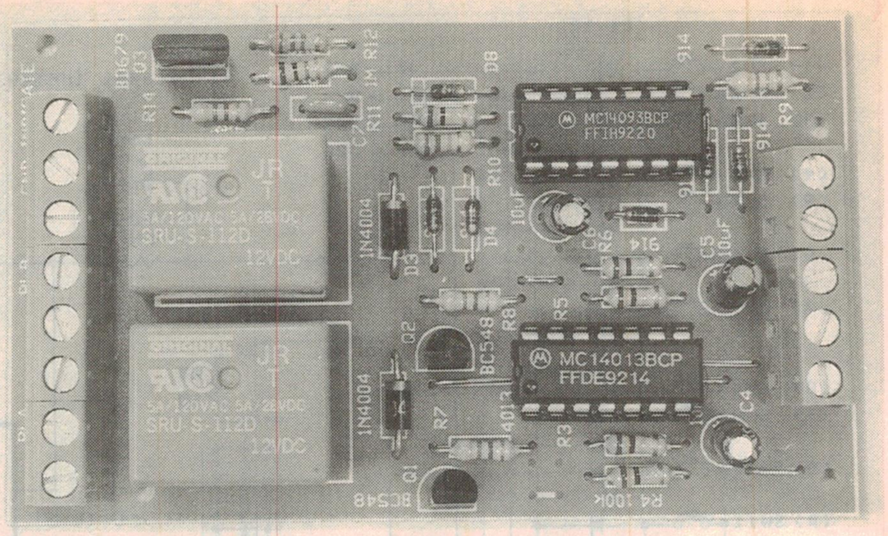


Fig.2: The pre-built receiver module contains all the circuitry to receive, amplify and detect the transmitted signal. The signal from the receiver is decoded by IC1 and fed to multiplexer IC2, sending the selected output high.

receiver and relay driver boards are all powered by a 12V DC supply, which can be mains derived or from a battery. Current consumption for the receiver is around 4mA and each relay output board takes virtually no current until a relay is energised.

On the prototype, current is about 40mA per relay. Therefore, the system is suited to battery operation, depending on the use you put it to.

We'll describe the three sections individually, starting with the transmitter...



Here's a shot of the relay board. Notice the links under the 4013.

The transmitter

The transmitter circuit is shown in Fig.1 and is based around a trinary encoder IC, type AX526. This IC has four data inputs and eight address lines that are connected to either a logic 1, logic 0 or left open-circuit. (The corresponding decoder in the receiver must have its address lines set the same as the encoder.)

The internal clock frequency of the IC is determined by the value of timing resistor R5, and the corresponding timing resistor for the decoder in the receiver section should have a similar value. The output of the encoder is at pin 17, which is fed to the RF section of the transmitter.

The data input lines to the encoder are connected via diode logic to the 12 keys on the keypad. The diodes implement a decimal to binary encoder, a function not available in IC form.

For example, if SW1 (key 1) is pressed, the binary code 0001 is presented to IC1. Pressing SW2 gives 0010 and so on. Resistors R1 to R4 hold the data inputs to IC1 low until a key is pressed, and the diodes present a logic 1 as required to each input.

When any key is pressed, power is also supplied to the circuit via diodes D23 to D26. Pressing SW1 causes D1 and D23 to be forward biased, for example, where D23 supplies power to the rest of the circuit. Power is supplied via D24 when SW2 is operated, and so on.

The RF section of the transmitter is based around transistor Q1 and features a 304MHz SAW (surface acoustic wave) resonator in the feedback path. This device is a narrow-band filter that resonates at 304MHz, giving a low impedance at this frequency.

Therefore, the oscillator is locked to 304MHz, and will only operate when its

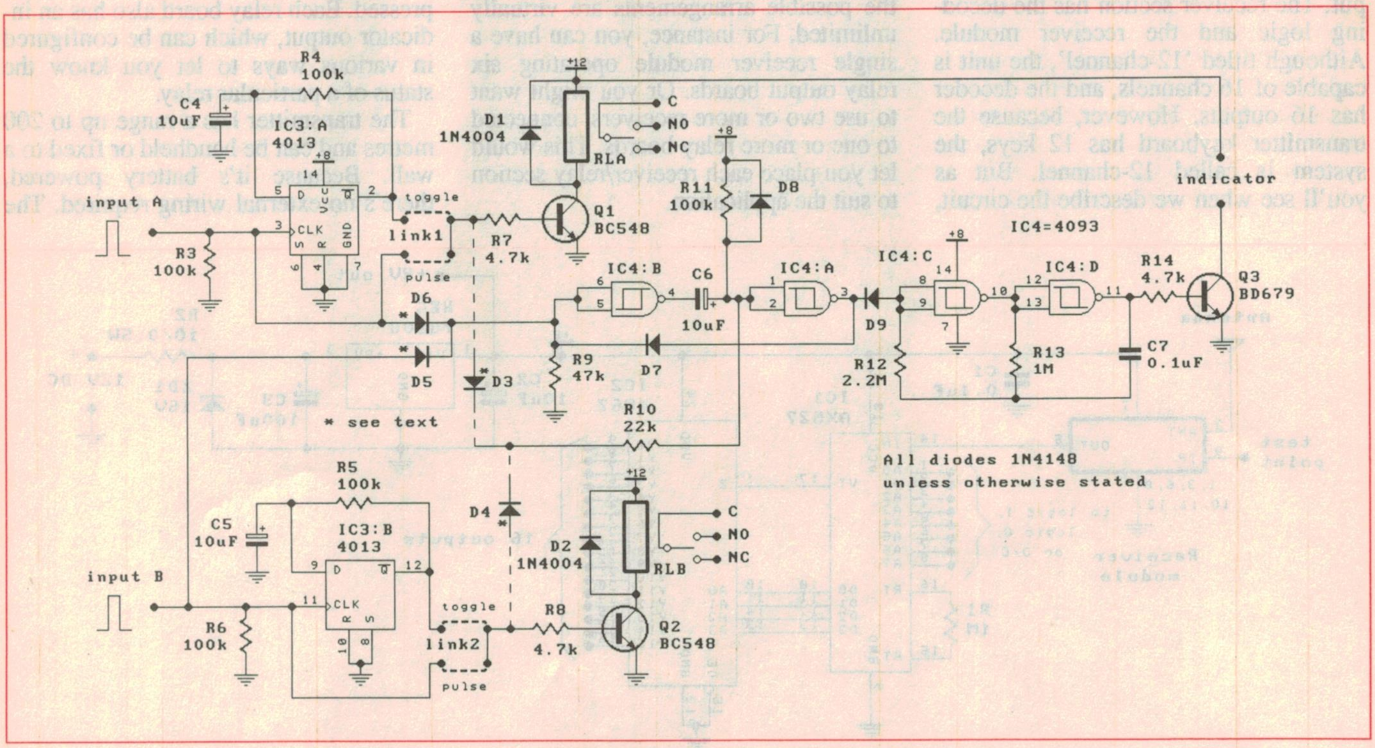


Fig.3: The transistors driving the relays are operated by either the input pulse or the output of the flipflops, depending on the position of the links. The indicator section around IC4 can be configured in various ways, and consists of a timer around IC4a-b and a low frequency oscillator around IC4c-d.

natural frequency is close to the resonant frequency of the SAW filter.

The operating frequency of the oscillator is peaked by C3, and the LED across R8 shows when the adjustment is correct. The current taken by the transmitter passes through R8, and because the voltage developed across R8 lights the LED, the higher the current (and the output signal), the brighter the LED. In practice, you need to first find the peak output, then back off the adjustment slightly to give the best range.

The digital data output of IC1 switches Q1 on and off, and the transmitter output is therefore a series of pulses modulated at 304MHz. The antenna is L1, which is etched on the PCB. Power for the transmitter is from a 9V battery and the current consumption is a few milliamps when a key is pressed, otherwise the battery is disconnected from the circuit.

The receiver/decoder

The circuit for this section is shown in Fig.2. The receiver module comes complete and already aligned to 304MHz. This module contains a bandpass filter, an RF preamplifier, a regenerative detector, an amplifier and a Schmitt trigger output. A short length of wire (100mm or so) as an antenna is connected to pin 2 and the output is from pin 5. The test point at pin 9 shows the detected output signal, at around 4Vp-p.

The output of the module is the original digital data sent by the transmitter, and this is applied to the input of trinary decoder IC1, type AX527. The address inputs of this IC should match those of the encoder in the transmitter, and the value of R1 (timing resistor) should also be equal to its equivalent in the transmitter.

In practice, these two resistors don't need to be exactly matched, and a spread of two to one is allowed. For instance you could have a 1M resistor in the transmitter and a 1.8M in the receiver. Values outside this range will usually prevent the decoder responding.

A valid signal from the receiver will cause pin 17 of the decoder to go high, enabling the outputs of IC2. As well, the binary data will appear at the data outputs (D0 to D3) of the decoder. This data is presented to the 16-channel multiplexer (IC2) and the corresponding output from the multiplexer will go high for as long as a valid transmission is present.

The transmitter circuit as shown can select outputs Y1 to Y12. Outputs Y1 to Y9 correspond to keys 1 to 9, and outputs Y10 to Y12 to keys 0, # and *

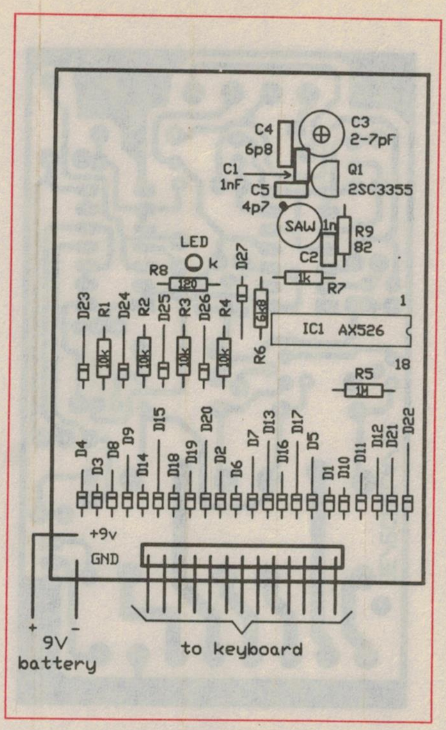


Fig.4: The transmitter layout is shown here. The contacts of the keypad socket should be at the outside edge of the board. All diodes except D27 have their cathodes facing towards the SAW filter. The diodes are all signal types.

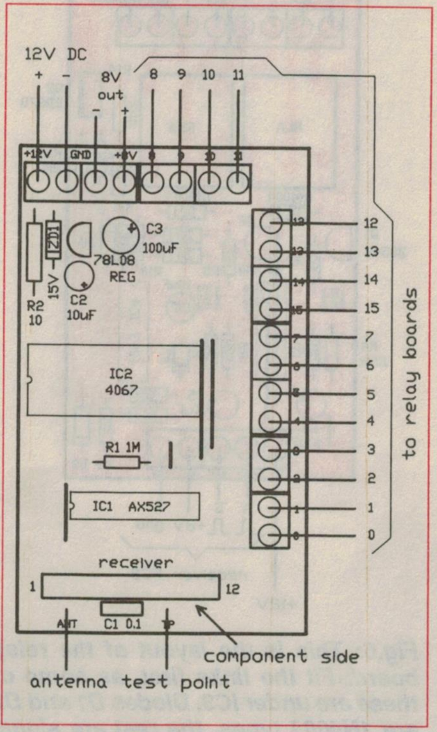


Fig.5: This layout is for the receiver/decoder PCB. The receiver module solders directly to the PCB. The onboard regulator supplies 8V to the relay driver boards.

respectively. To select output Y0 (and thereby gain another channel), an extra pushbutton could be added to the transmitter, connected from the battery (+ve) directly to the cathodes of the D23-D26. The remaining three channels would need diode logic to present the correct code to the encoder.

The supply voltage to the circuit is regulated by an 8V regulator, type 78L08. The 12V DC input source is limited by R2 and ZD1. This regulator also supplies 8V to the logic on the relay boards.

The relay driver

The relay driver circuit is shown in Fig.3 and includes logic and drivers for two relays as well as a status indicator around IC4. The 12V relays are driven by the transistors, and diodes D1 and D2 protect the transistors against the back EMF produced by the relay coil at switch off. The links select either toggle or pulse operation. When set to pulse, the relevant transistor (and hence the relay) is turned on only while its transmitter key is held on. Releasing the key turns off the relay.

In toggle operation, the transistor is operated by the output of the flipflop (IC3a, IC3b). In this case, a pulse at the input clocks the flipflop, causing it to change state at each pulse.

This is achieved by connecting the Q-bar output to the D input, via a time delay network comprising a 100k resistor and a 10uF capacitor. This delay prevents false toggling due to an interrupted transmission.

The indicator section

The indicator circuit can be used in a variety of ways. It has two parts: a monostable around IC4a and b, and a low frequency oscillator around IC4c and d.

If diodes D6 and D3 are connected (with D4 and D5 disconnected) the circuit will produce three pulses to Q3 when relay A is turned on, and one pulse when the relay is turned off. Each pulse lasts about half a second.

With this configuration, when a logic 1 appears at the anode of D6 (from input A), D6 is forward biased, applying a high to the input of IC4b, sending its output low. This allows C6 to charge via R11. However, until C6 charges sufficiently, the input to IC4a will be low, and its output high. This will forward bias D7, holding the input to IC4b high, keeping the timer in this state.

When C6 has charged sufficiently, the input to IC4a will be high, and its output will switch low, reverse biasing D7.

Remote Control

However, if the input to IC4b is still high, its output will remain low and nothing further happens.

When the signal at the anode of D6 switches low, D6 is reverse biased, and the input to IC4b will be pulled low by R9, sending its output high. This will discharge C6, because there is now no longer a potential difference across it. The discharge path is through D8 to the supply and C6 discharges rapidly, making it ready for the next timing cycle.

If relay A is set to toggle mode with link A, the output of IC3a will now be high. This effectively places R10 in parallel with R11, as R10 is now connected via D3 to a voltage almost equal to the supply voltage. When the second pulse is received to toggle relay A off, the time delay to charge C6 is smaller, due to the lower value of series resistance. Therefore the monostable is in its unstable state for about a quarter of its previous time.

In other words, when the relay is toggled on, the monostable time delay is determined by C6 and R11. When the second pulse occurs to switch the relay off, the time constant is set by C6 and R11 in parallel with R10.

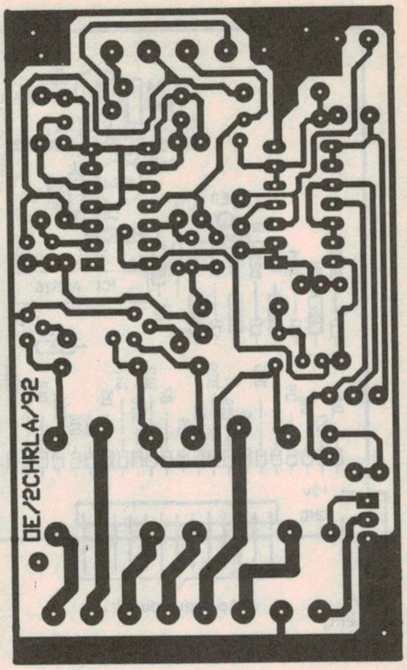
Now to the operation of the oscillator around IC4c and d, which is controlled by the monostable. Normally, the output of IC4a is low, forward biasing D9 which gives a low to the input of IC4c. The output of IC4c is therefore high and the output of IC4d low, holding transistor Q3 off. That is, both the oscillator and the indicator driven by Q3 are off.

When the output of IC4a is high (monostable in its unstable state), D9 is reverse biased and the oscillator of IC4c and d will operate. Under these conditions, the feedback via R13 and R12 will cause a conflict between the input and output logic levels of IC4c, making the circuit oscillate.

However, C7 will slow the oscillating frequency. For example, when the output of IC4d switches high, due to the low at its input, C7 will charge via R13 and the output of IC4c. This will hold the input of IC4c high (and its output low) until C7 has charged.

After about half a second, C7 will be charged and the low at the output of IC4c is now coupled back to its input via R13 and R12, making the output of IC4c change state. Now C7 discharges, this time through R13 and the output of IC4d. When it discharges sufficiently, the oscillator commences its next cycle.

When the output of IC4d is high, transistor Q3 is turned on, and a buzzer or a lamp connected as shown will operate. The on-time of the monostable (when a relay is first turned on) is long enough to allow the oscillator to cycle three times. When the relay is turned off, the monostable only allows time for one cycle of the oscillator.



This is the artwork for the relay board, reproduced full size if you want to make your own.

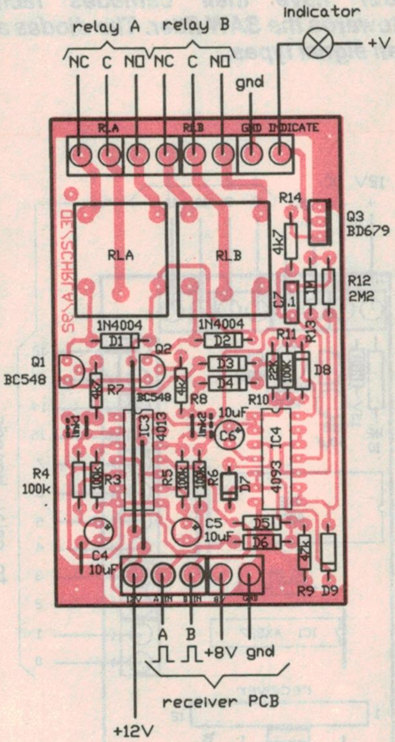


Fig.6: This is the layout of the relay board. Fit the links first, as some of these are under IC3. Diodes D1 and D2 are 1N4004 types, the rest are signal diodes. The screen printing for boards supplied by Oatley Electronics may show the 12V and 8V connections incorrectly. Those shown here are correct.

Indicator options

You can see that if D4 is also connected, it will interfere with the timing of the monostable when relay B is on. As well, if either D3 or D4 are connected, the time delay of the monostable will be at a minimum if either relay is on. Therefore, switching on the second relay will give a single pulse of the indicator, rather than three.

Therefore, there are a number of options on how to configure the indicator. The first is give an indication of the status of one of the two relays in toggle mode. For relay A, connect D6 and D3 as already described and leave D5 and D4 disconnected.

For relay B, connect D5 and D4, leaving D6 and D3 disconnected. This option is only useful for the toggle mode and will give three pulses of the indicator when the selected relay is turned on, and one when its turned off.

The next option applies to either toggle or pulsed mode. Here you can have both D5 and D6 connected, with D3 and D4 disconnected. In this option, three pulses are produced whenever a pulse is applied to either input A or B, giving feedback when a transmitter key is pressed. Obviously, you can have *either* D6 or D5 connected to indicate operation of either relay A or B. Again the indication will be the same when the relay is turned on or off.

If you don't need the indicator section at all, leave the relevant components off the PCB. In many cases, the status of a relay will be obvious, because you can see the device being switched. The indicator is included so you can use it when the controlled device is located out of sight (and hearing).

Transmitter PCB

Construction of the transmitter requires the components to be loaded onto the PCB as shown in the layout diagram of Fig.4 and the keypad to be attached to the case. A ribbon type cable from the keypad plugs into a socket fitted to the PCB.

The recommended case has three sections and clips together, held by two screws in the battery compartment. The bottom section contains the battery compartment and the PCB is held to the bot-

PARTS LIST

TRANSMITTER

Resistors

All 1/4W:

R1-R4	10k
R5	1M
R6	6.8k
R7	1k
R8	120 ohm
R9	82 ohm

Capacitors

C1,C2	1nF ceramic
C3	2-7pF trimmer
C4	6.8pF ceramic
C5	4.7pF ceramic

Semiconductors

IC1	AX-526 trinary encoder
Q1	2SC3355 NPN transistor
D1-D27	1N4148/1N914 signal diodes
LED	5mm red LED

Miscellaneous

Silk-screened PCB, 60 x 85mm; 304MHz SAW filter; 12-key keypad; 13-pin PCB mount in-line socket for keypad; 9V battery and battery clip; suitable plastic case; tinned copper wire; hook-up wire.

RECEIVER/DECODER

Resistors

R1	1M, 1/4W
R2	10 ohm 1/2W

Capacitors

C1	0.1uF monolithic
C2	10uF/25V electrolytic
C3	100uF/25V electrolytic

Semiconductors

ZD1	15V, 1W zener diode
IC1	AX-527 trinary decoder
IC2	4067 CMOS multiplexer
REG	78L08 voltage regulator (8V TO92)

Miscellaneous

Silk-screened PCB, 88 x 52mm; pre-aligned 304MHz receiver module; 24-pin IC socket; 18-pin IC socket; tinned copper wire; hook-up wire.

RELAY/INDICATOR

Resistors

All 1/4W:

R3-R6,R11	100k
R7,R8,R14	4.7k
R9	47k
R10	22k
R12	2.2M
R13	1M

Capacitors

C4,C5,C6	10uF/25V electrolytic
C7	0.1uF monolithic

Semiconductors

D1,D2	1N4004 1 amp diodes
D3-D9	1N4148/1N914 signal diodes
IC3	4013 dual D flipflop
IC4	4093 quad Schmitt NAND
Q1,Q2	BC548 NPN transistor
Q3	BD679 NPN transistor

Miscellaneous

Silk-screened PCB, 65 x 90mm; 2 x 12V PCB mount relays; tinned copper wire; hook-up wire.

Kits of parts for this project are available from:
Oatley Electronics
5 Lansdowne Parade,
Oatley West, NSW 2223.
Phone (02) 579 4985

Postal address (mail orders):
PO Box 89, Oatley West NSW 2223.

Transmitter kit, all components, silk-screened PCB and keypad...	*$35*
Case for transmitter...	*$11*
Receiver/decoder kit, complete...	*$56*
Relay/indicator kit, complete...	*$26*
Package deal, includes two transmitter kits with cases, one receiver kit, three relay kits...	*$200*
Packing and Postage...	*$5*

tom of the case with four self-tapping screws that screw into spigots moulded to the case. Of course, you might want to use another type of case, depending on the application.

To fit the keypad, cut a 41mm wide slot in the top of the case to allow the ribbon cable to pass through. The keypad has an adhesive surface and glues directly to the top of the case. The keypad is actually in two sections: the keytop and the contact assembly. You'll need to run a thin strip of glue (contact glue or similar) on the underside, around the perimeter of the keytop to glue it to the contact assembly.

Perhaps the most notable thing about the transmitter PCB is the number of diodes: 27 in all. Apart from D27, all diodes face the same way, with the cathode end towards the SAW resonator. Start with the diodes, then mount the resistors and capacitors.

The socket for the keypad can then be fitted. This 13-pin socket should be mounted so its contacts are along the *outside* of the board. You'll notice that the keypad cable has contacts on one side only, and these have to mate with the contacts in the socket.

Finally, fit the SAW resonator, the transistor and the IC. The SAW resonator has a tab to show its orientation, although its terminals make incorrect placement impossible. The resonator should be mounted so it sits on the surface of the PCB.

The IC can be soldered directly to the board, with pin 1 facing the right side of the board. At this stage, leave the address lines open-circuit. The LED has its cathode towards the right side of the board. The transistor should be mounted no higher than about two or three millimetres above the PCB surface.

At this stage, attach the battery clip and plug the keypad cable into the socket. Connect a 9V battery and you should be able to see the LED light when a key is pressed. Using a non-magnetic screw-driver (plastic or brass), adjust C3 to give a maximum output. If the LED doesn't light, check that the keypad cable is connected properly. Otherwise, check the orientation of diodes D23-D26.

Receiver/decoder PCB

This board is the simplest of all and the layout is shown in Fig.5. Fit the power supply components first, the four links and the IC sockets (if they're being used). Before fitting the receiver module and the IC's, you might want to check the power supply section.

With 12V DC connected to the board, confirm that the output of the regulator is 8V DC. Then solder the receiver module in place, arranged so that the component side faces out. Follow by fitting the two IC's. Also connect a 100mm (or so) length of wire for the antenna. As with the transmitter, leave the address pins of IC1 open-circuit.

To test the receiver, monitor the voltage at pin 1 of IC2. You should find that this voltage switches high when a key is pressed on the transmitter. If not, check the test point of the receiver. The signal should be digital data at a relatively low frequency, with a peak value around 4V.

If all is well, confirm that outputs Y1 to Y12 are selected when the corresponding key is pressed on the transmitter. A selected output will be high while its transmitter key is pressed.

Relay PCB

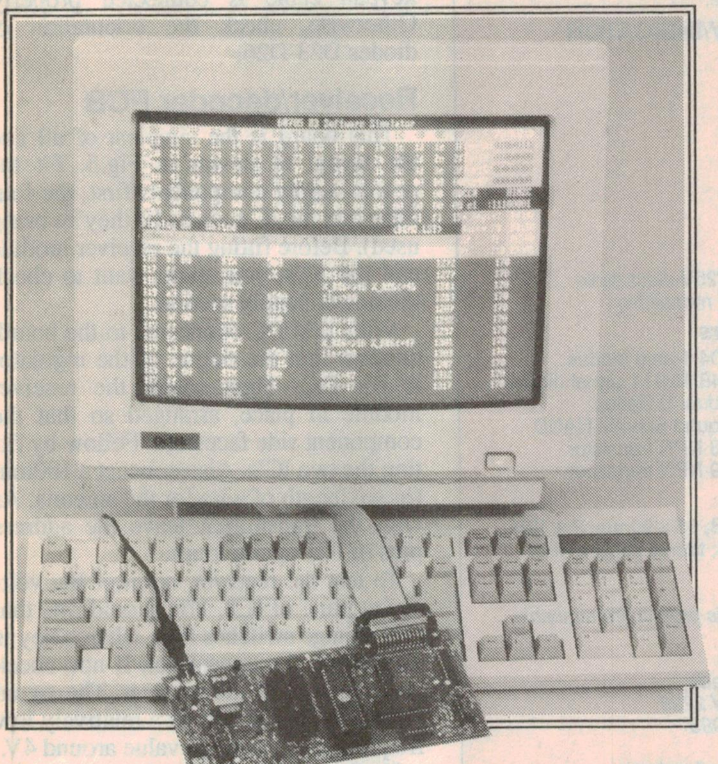
The layout for this board is shown in Fig.6. The PCB artwork for this board is also included, shown in Fig.7. Before fitting any components, decide on how you want to configure the indicator section. If you don't want to use this section, leave its components off the board. Also determine how you want to operate the relays, so you know the position of links 1 and 2. The layout shows the links in the 'toggle' mode for both relays. The dashed links are for pulsed mode.

Start with the links, as two of these are fitted under IC3. Then fit the passive components, taking care with the orientation of the diodes and the electrolytic capacitors. Also fit the IC sockets. Follow with the transistors and the relays.

To test the board, connect the 8V input to the corresponding 8V output from the receiver/decoder board. Also connect the 12V DC supply. The board should take virtually no current from the 12V DC supply until a relay is energised.

Before you connect the A and B inputs to the receiver/decoder board, confirm that the inputs operate their relays by applying 8V DC to each input.

Continued on page 93



Low cost PC-based 68705 Development System

Here's a complete development package for the 68705U3/R3 and 'P3 single-chip microcomputer ICs. This exciting project has two parts: software for an IBM (or compatible) PC, and hardware that lets you directly program a 68705 from the PC. It therefore has all the tools you'll need to develop applications for these versatile devices, and all for less than $250.

by ROBERT PRIESTLEY

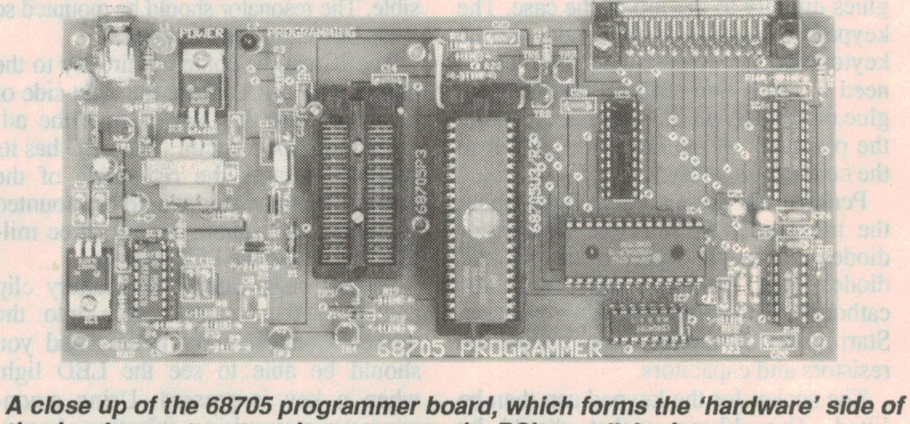
This project was developed because I wanted to design a particular project around the 68705 single-chip microcomputer. However the process proved to be so tedious that I eventually realised a 68705 development package was the only way to get anywhere. The usual procedure when using a 68705 is to write the program, load it into an EPROM and then copy its contents to the EPROM in the 68705. Any changes to the software require this process to be repeated, usually many times until you get it right — sound familiar?

But because commercial development packages cost anywhere from $700 up to several thousand dollars, I decided to produce my own.

The first thing you need is a cross-assembler so the program for the 68705 can be written and developed on a computer. Fortunately, Motorola itself provides a freeware cross-assembler with full documentation.

Next is a simulator, so the program can be tested and debugged on the computer — much quicker than debugging it in the 68705! Then you need hardware, so the developed program can be downloaded *directly* from the computer into the EPROM in the 68705. This all took quite a bit of time to complete, but does this project match up with a commercial package? Most definitely!

The package is in two parts: the hardware and the software. The hardware is contained on a professional



A close up of the 68705 programmer board, which forms the 'hardware' side of the development system. It connects to the PC's parallel printer port.

quality, double-sided plated through, screen-printed PCB, which connects to an IBM type personal computer. The PCB is therefore easy to construct and because it connects to a parallel printer port, you don't need a special interface card to run it.

The software includes the freeware Motorola 68705 cross-assembler, a file to operate the hardware and a simulator so you can simulate (and debug) 68705 code on an IBM PC. In other words, the package has everything you need to develop an application for the 68705 microcomputer.

By the way, this project will be sold by Oatley Electronics as a complete kit only and includes all software, hardware, documentation and demonstration programs to get you up and running. For details see the end of the article.

The 6805 family

Single-chip microcomputers such as the 68705 are probably one of the most versatile ICs around. They're now used in test equipment, industrial controllers, sophisticated alarm systems, and even domestic appliances such as dishwashers, electronic ovens, remote controls etc.

There's also quite a few projects appearing in magazines (including *EA*), so obviously the microcomputer is now becoming a part of the hobbyist scene.

All members of the 6805 microcomputer family are designed around a common core consisting of a CPU, timer, oscillator, ROM, EPROM, RAM, the control section and bi-directional I/O lines. As well, each version within the family has a combination of options unique to that version. These include different capacity EPROM and RAM, various numbers of I/O lines and external interrupt lines. Some versions also have an A/D converter or a serial interface. The type number for the EPROM versions have a 7 (such as the 68705R3); the ROM versions are simply 6805xx.

The main advantage of a single-chip microcomputer over a discrete microprocessor system is that all the data and address busses, address decoding, control logic and I/O are in the IC. This gives a smaller and less complex circuit board, with a much reduced chip count and cost. A designer's dream!

The version described in this article is the 68705R3, although the hardware also supports the 68705P3/U3. The 'P3 (and 'U3) have less EPROM (1804 bytes compared to 3776 in the 'R3), there is no A/D converter on board and there are less I/O lines.

The 'P3 is therefore smaller, with 28 pins, while the 'R3 has 40 pins. For this reason, there are two ZIF sockets on the programming board to take either type.

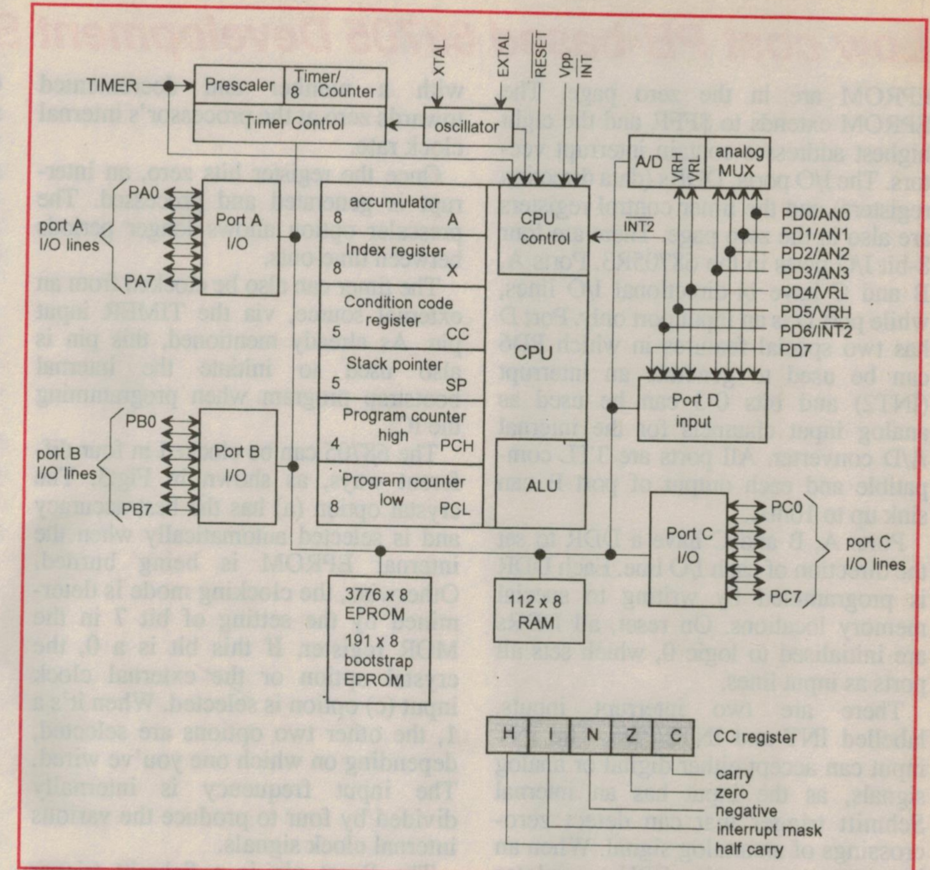


Fig.1: The internal block diagram of the 68705R3 microcomputer. The flags in the condition code register are also shown.

Inside the 68705R3

The block diagram in Fig.1 shows the internal architecture of the 68705R3. The CPU section contains an ALU (Arithmetic Logic Unit) and controller, Accumulator, Index Register, Condition Code Register, Stack Pointer and Program Counter Register.

The Control Unit sequences the micro-computer system, decodes each instruction, and generates all necessary signals. The ALU performs arithmetic and logic operations.

The Accumulator is a general purpose 8-bit register that holds the results of arithmetic calculations or data manipulations. The Index register is an 8-bit register for the indexed addressing mode. It can also be used as a counter.

The CC (Condition Code Register) is a 5-bit flag register that shows the results of an operation. Each bit (flag) can be tested, and action initiated as a result. As shown at the bottom of Fig.1, the bits are (from bit 0) a carry, zero, negative, interrupt and a half-carry flag.

The Stack Pointer is a 12-bit register with the seven most significant bits permanently set to 0000011. After a reset or a Reset Stack Pointer (RSP) instruction, the stack pointer is set to $07F (hexadecimal 7F) and up to 31 bytes of the on-board RAM can be used as the stack ($07F to $061).

The Program Counter is a 12-bit register holding the address of the next byte to be fetched by the CPU.

The memory map of the 68705R3 is shown in Fig.2. As you can see, the IC can address 4096 bytes (addresses $000-FFF) of memory and I/O registers. The memory comprises user EPROM (3776 bytes), bootstrap ROM (191 bytes), and 112 bytes of user RAM. The bootstrap ROM is already programmed (hence the term ROM) and contains the EPROM burner program. When 12V is applied to the TIMER input, the bootstrap program loads code from an external memory device and burns the internal EPROM. It also verifies that the internal EPROM has an exact copy of the external memory device.

There is one byte, at $F38, reserved for the EPROM mask option register (MOR). This location is a 6-bit register used to select the type of system clock, the timer option and the timer/prescaler clock source.

All of the RAM and 128 bytes of the

Low cost PB-based 68705 Development System

EPROM are in the zero page. The EPROM extends to $FFF, and the eight highest addresses contain interrupt vectors. The I/O ports, DDRs (data direction registers) and the timer control registers are also in the zero page. There are four 8-bit I/O ports in the 68705R3. Ports A, B and C have bi-directional I/O lines, while port D is an input port only. Port D has two special features in which PD6 can be used to generate an interrupt (INT2) and bits 0-3 can be used as analog input channels for the internal A/D converter. All ports are TTL compatible and each output of port B can sink up to 10mA.

Ports A, B and C have a DDR to set the direction of each I/O line. Each DDR is programmed by writing to special memory locations. On reset, all DDRs are initialised to logic 0, which sets all ports as input lines.

There are two interrupt inputs, labelled INT and INT2/PD6. The INT input can accept either digital or analog signals, as the input has an internal Schmitt trigger that can detect zero-crossings of an analog signal. When an interrupt occurs, the CPU completes execution of the current instruction, saves the state of the registers onto the stack, then executes an interrupt service program which is found in the interrupt vector table.

The 68705R3 also has an 8-bit Timer Data Register (TDR) with an optional 7-bit prescaler. The timer is an 8-bit countdown register which can be loaded with a number and decremented towards zero at the processor's internal clock rate.

Once the register hits zero, an interrupt is generated and processed. The prescaler option allows longer periods between time-outs.

The timer can also be clocked from an external source, via the TIMER input pin. As already mentioned, this pin is also used to initiate the internal bootstrap program when programming the IC.

The 68705 can be clocked in four different ways, as shown in Fig.3. The crystal option (a) has the best accuracy and is selected automatically when the internal EPROM is being burned. Otherwise, the clocking mode is determined by the setting of bit 7 in the MOR register. If this bit is a 0, the crystal option or the external clock input (c) option is selected. When it's a 1, the other two options are selected, depending on which one you've wired. The input frequency is internally divided by four to produce the various internal clock signals.

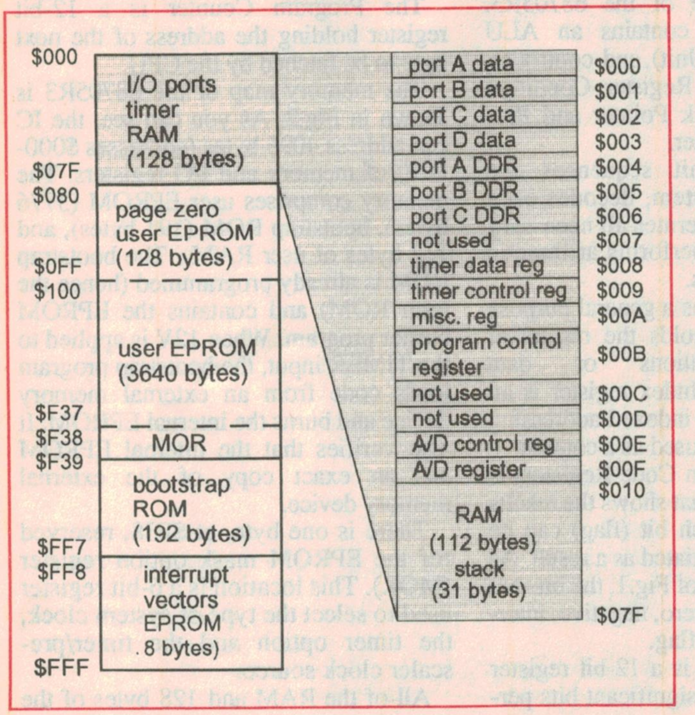
The Reset pin is a Schmitt trigger input and has an internal pull-up resistor. A 1uF electrolytic capacitor is usually connected to this pin to reset the chip at power-up. The Vpp pin is used when programming the internal EPROM.

Writing software

As already described, the usual method of developing software for a 68705 is to write the program in mnemonic form with a text editor and to then run the text through a cross-assembler program which produces the assembled code. Then the code contained in the file has to be downloaded to an EPROM, via an EPROM burner card. The contents of the EPROM are then transferred to the 68705's EPROM via a hardware interface. Motorola give details of a suitable interface in their data sheets.

Motorola have also produced various freeware cross-assemblers, so a 'bare-bones' system is available for the cost of the parts to make the hardware interface. For a one-off, simple application, such a system is probably sufficient. However in most cases perfecting the program will involve a lot of trial and error, along with repeated erasing and burning of EPROMs. At best it's a tedious process, which usually takes 'forever' if the application program is more than a few hundred bytes.

The answer is a computer *simulator*. A simulator lets you 'dry run' the 68705 program on a computer, such as an IBM compatible and to see the results via a screen display. Any errors can be corrected without having to go through the process of actually burning the EPROM in the 68705. This, plus the hardware interface that directly transfers the object code to the 68705 (rather than via an intermediate EPROM) speeds the process considerably.



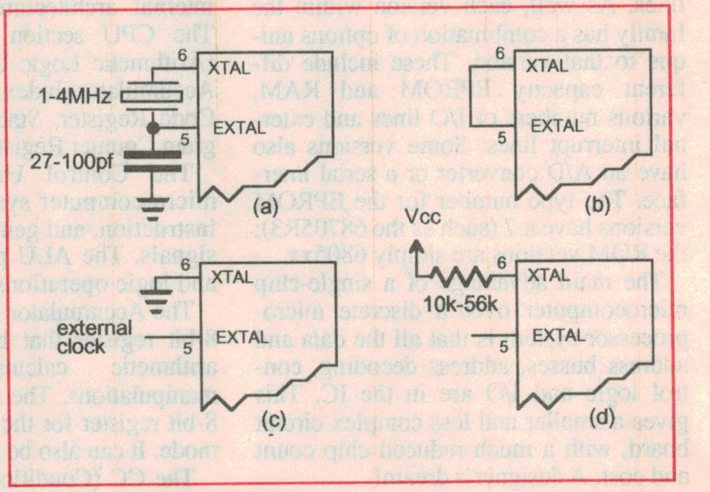


Fig.3 (above): The four ways of clocking the 68705. Mode (a) is forced when the internal EPROM is being programmed, otherwise it and options (b) to (d) are determined by bit 7 of the MOR register.

Fig.2 (left): The memory map of the 68705R3. Port A and port B DDR registers are write only — they read as $FF.

We'll start by describing the software that will be supplied with this project. First the cross-assembler...

The cross-assembler

This program is a Motorola freeware package, included free of charge. A document file written by Motorola is included, describing how to use the cross-assembler. The documentation is quite comprehensive, and takes up 31 pages when printed. Therefore, there's no need for the cross-assembler to be described in detail here.

A cross-assembler is a computer program that takes assembly language mnemonics written and edited on one computer (the 'host') and translates them into executable code for another computer (the 'target'). In this case the host computer is an IBM compatible PC and the target computer is a 6805 microcomputer.

It's worth noting that there are a number of software packages that allow you to write code in a high level language such as 'C', then compile the source code into 6805 code. The usual method of producing the 6805 code is to write the assembly language in a text editor, save the text file to disk as an ASCII file and to send it to a cross-assembler to assemble the code. The cross-assembler then creates an object file in Motorola's 'S record' format (.s19 extension). The S record file can then be downloaded to the 68705. You can also make the cross-assembler produce a composite print file that includes the mnemonics, labels and comments as well as the hex code, for your records and documentation.

Software simulator

Developing software for single-chip microcomputers requires special techniques. Because everything is inside the IC, debugging and running a program is nearly impossible without the correct software or hardware tools.

One method is to use a hardware emulator, but these are usually too expensive for most people so the alternative is software simulation. The simulator program supplied with the kit supports the 68705 P, U and R series chips. Others will be added, if there's enough demand. The simulator can also be used with any 6805 code and has all the features of a commercial package costing hundreds of dollars.

The screen display of the simulator is depicted in Fig.4. This diagram has been drawn rather than photographed, and shows the display much as you would see it after running the demonstration program DEMO.S19. This program simply fills the 68705 RAM with sequential numbers.

As you can see, the simulator screen is broken up into a number of areas including the RAM contents, register contents, I/O port status, the command line, status line and trace area (program listing). As each instruction is executed, the contents of memory, registers, I/O ports, etc are automatically updated on the screen. A screen trace is also displayed which shows information such as the memory location, opcode and operands, instruction summary, total clock cycles and total number of interrupt clock cycles.

As each instruction is executed, the screen trace scrolls upwards. The current instruction and the next instruction to be executed are shown at the bottom of the screen.

The RAM contents area has a number of special features. The last byte of RAM written to is highlighted in red, and any RAM being used by the stack is highlighted in yellow.

The port areas display the individual bits in each port, their value and their direction as set up in the Data Direction Register. A blue bit shows an output and a red bit represents an input. If a program reads the I/O ports, and one or more bits are set as an input, the simulator will ask for a value (in hex) for the input bit/s.

All interrupts, including software, timer and external interrupts are supported by the simulator. While a program is being simulated, an external interrupt can be invoked from the keyboard.

The main registers, which include the Accumulator, X register, Condition Code Register, Stack Pointer and Program Counter are always displayed on the simulator screen. The view command lets you display the addressable registers such as the Mask Option Register, Timer Control Register, Program Control Register, A-D register etc. This command creates a window over the RAM area and displays these registers along with the interrupt vectors. The register display is shown in Fig.5.

The usual complement of debugging commands are supported by the simulator. These include single-stepping so the effects of each instruction can be seen, and you can alter the contents of any memory location or register at any time.

Up to three breakpoints are available, to stop the simulation when a specified address is reached. A listing of the source program can be displayed on the screen while tracing through a program. A trace can be saved to disk for future reference. Incidentally, the

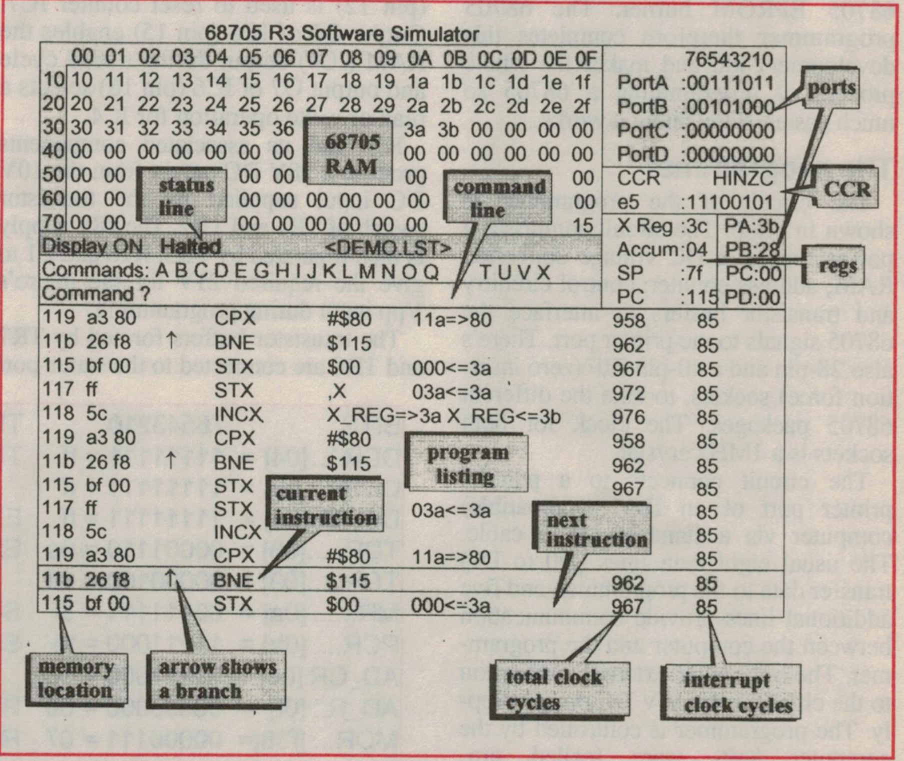


Fig.4: The simulator lets you single-step or run a program for the 68705R3, P3 or U3 MCUs on an IBM compatible. It shows exactly what's happening so you can debug the program before burning it into the EPROM.

Low cost PC-based 68705 Development System

simulator can't be crashed by a program under any conditions.

In other words, the simulator lets you completely debug 6805 code before committing it to silicon, eliminating 'the burn and crash' method of writing and debugging software for these devices.

Burning the 68705

As we've explained, the usual way of downloading a program to the 68705 is to first burn a standard EPROM using an EPROM burner card. These usually cost around $230.

This EPROM and the 68705 are then placed into a special 68705 EPROM burner (costs about $100), which is described in various Motorola data books. Using the internal bootstrap program, the 68705 then reads the data from the external EPROM and copies it into its internal EPROM.

While this system works well enough, it is time consuming and rather messy. To get around this, the hardware with this project accepts the program from the computer parallel printer port and transfers it directly to the 68705 EPROM.

Apart from streamlining the procedure, the total cost is less, unless you already have an EPROM burner card. Even then, you still have to build the 68705 EPROM burner. The 68705 programmer therefore completes this development kit, and makes the whole process of programming a 68705 so much easier. Here's how it works...

The programmer

The circuit of the programmer is shown in Fig.6. The circuit comprises a power supply, a DC voltage converter, RAM, address counter, control circuitry and transistor buffers to interface the 68705 signals to the printer port. There's also 28-pin and a 40-pin ZIF (zero insertion force) sockets, to take the different 68705 packages. The clock for both sockets is a 1MHz crystal.

The circuit connects to a parallel printer port of an IBM (compatible) computer via a standard DB25 cable. The usual eight data lines (D0 to D7) transfer data to the programmer, and five additional lines provide communication between the computer and the programmer. The only other external connection to the circuit is the 12V DC power supply. The programmer is controlled by the computer soft- ware (called program.exe), which will be supplied with the kit.

Control is achieved by IC6, an octal latch that connects directly to the computer's printer port. A control byte is sent to the printer port and is latched into IC6 by a pulse at bit 1 (pin 14 of the DB25 connector). Output Q1 of IC6 (pin 2) is used to switch the programmer's power on and off via the transistor switch formed by TR1 and TR2. Note that power is always supplied to IC4, 5, 6, 7 and IC8 via the 5V regulator of IC2.

Output Q2 of IC6 (pin 5) controls the voltage to the Vpp input of the 68705 via the circuit around TR3-5. When this output is high, TR4 is turned on, switching TR3 off. Diode D3 then supplies 5V to the Vpp terminal at both ZIF sockets. This also occurs when TR5 is turned on by the 68705 itself. When TR4 and TR5 are off, there will be 22V at the base of TR3, causing it to turn on. The voltage at the Vpp terminals will then be about 21.4V, as D3 is now reverse biased. This condition is required to program the 68705 EPROM.

Output Q3 of IC6 (pin 6) is used to reset the 68705. A low at this output turns on TR6, which shorts the RESET terminal at both ZIF sockets, holding the 68705 in a reset condition. Output Q4 of IC6 (pin 9) enables the output of IC5, a three-state buffer, which isolates the printer port from the 6164 RAM (IC4) during a read cycle. Output Q5 of IC6 (pin 12) is used to reset counter IC7. Output Q6 of IC6 (pin 15) enables the RAM (IC4) output during a read cycle and output Q7 of IC6 (pin 16) selects a read or write operation for IC4.

IC3 and its associated components produce a 28V DC output from the 10V DC input supplied by the transistor switch of TR1 and TR2. The 28V supply is then regulated by TR3, R10 and Z1 to give the required 21V for the micro's Vpp input during programming.

The transistor buffers formed by TR7 and TR8 are connected to the status port bits 6 and 5 of the printer port. These two inputs indicate that the 68705 has been programmed and verified.

Programming sequence

The first step is to download the program to the 6164 RAM. To do this, the output of RAM address counter IC7 is reset to zero, IC5 is enabled, 'write' is selected on the RAM and power to the ZIF sockets is turned off.

This is done by the computer program and then the first data byte is sent via data lines D0 to D7 of the printer port. This data is written to the RAM by pulsing the CS2 terminal (pin 26 of IC4). The next address in the RAM is selected by clocking the address counter IC7 via control bit 3 (pin 17 of the DB25 connector). The sequence is repeated, until all memory locations have been cycled through and the required data has been dowloaded.

The 68705 is then checked to confirm that its internal EPROM is blank. Once this is done, it remains to transfer the RAM data into the 68705 EPROM. The next instruction from the computer turns on the power to the ZIF sockets, sets the programming voltage to 21V (at Vpp), disables the output of IC5 and enables the output of the RAM (IC4) via the Q6 output (OE) of IC6.

The reset terminal is then switched high by the next instruction, taking the 68705 out of the reset condition. The bootstrap program in the 68705 then takes over, communicating via I/O ports A (input for data transfer) and B (output, lines PB0, PB3 and PB4). A reset signal (RST2) is produced by PB4, resetting IC7 (address counter) to zero. The RAM data is then read via port A into the EPROM, and a clock pulse is produced by PB3, incrementing the address counter. The next data byte from the RAM is stored in the EPROM and the

BITS	76543210	TIMER_INT_VECT_HIGH.. [ff8]	= 01
DDRA..[04] =	11111111 = ff	TIMER_INT_VECT_LOW... [ff9]	= 2b
DDRB..[05] =	11111111 = ff		
DDRC..[06] =	11111111 = ff	EXT1_INT_VECT_HIGH..... [ffa]	= 01
TDR.....[08] =	00001110 = 0e	EXT1_INT_VECT_LOW...... [ffb]	= 50
TCR.....[09] =	00000100 = 04		
MR...... [0a] =	00111111 = 3f	SOFT_INT_HIGH_BYTE.... [ffc]	= 01
PCR..... [0b] =	11111000 = f8	SOFT_INT_LOW_BYTE..... [ffd]	= 57
AD_CR.[0e] =	01111000 = 78		
AD_R.. [0f] =	00000000 = 00	RESET_INT_HIGH_BYTE.. [ffe]	= 01
MOR... [f38]=	00000111 = 07	RESET_INT_LOW_BYTE... [fff]	= 00

Fig.5: At the press of a key, you can view all internal registers at any point in the program.

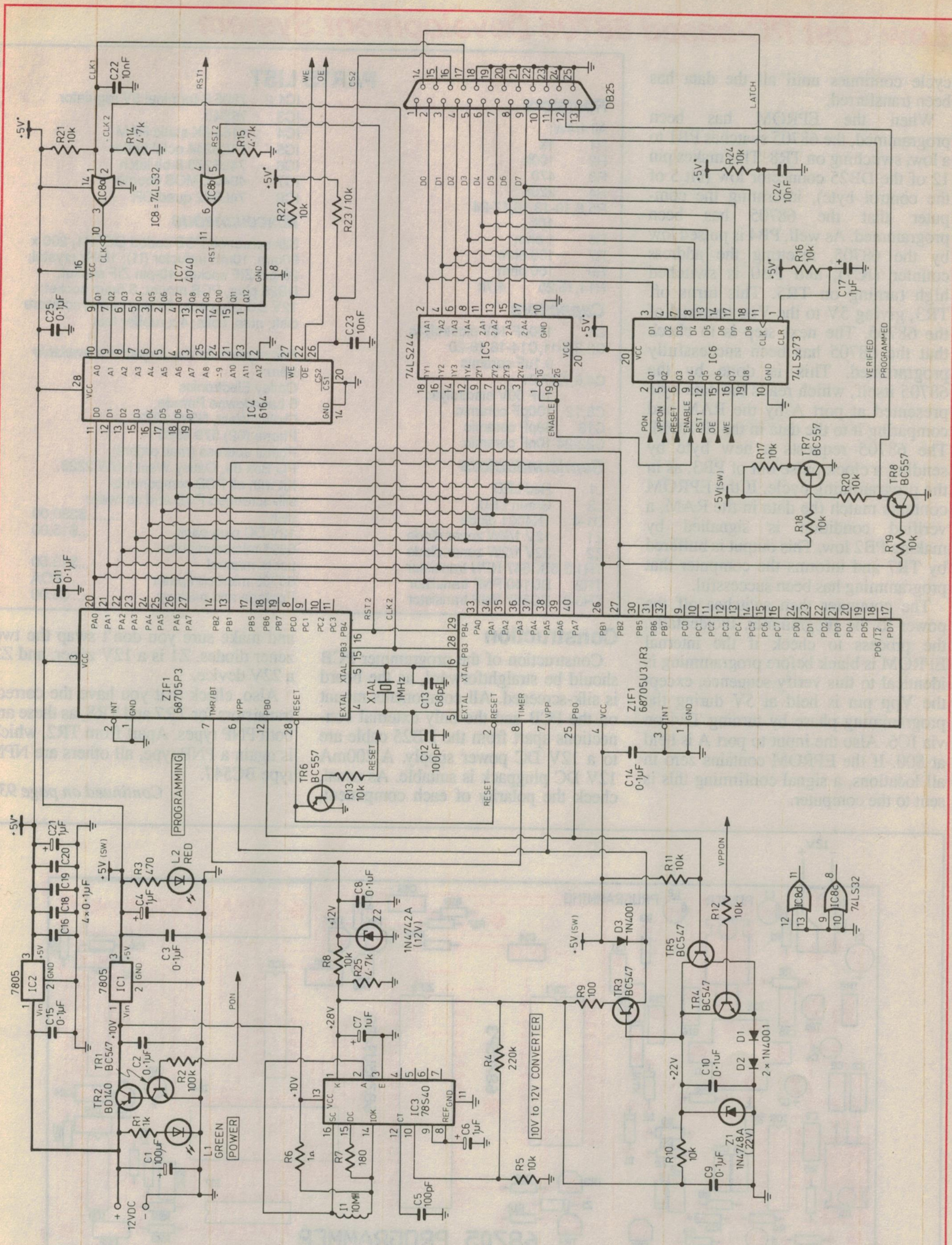


Fig.6: The circuit is simpler than it might first appear. ICs 4 - 8 are controlled by the computer and by the 68705 being programmed. IC2 supplies 5V to ICs 4 - 8, and IC1 and IC3 provide power that is switched by pin 1 of IC6.

cycle continues until all the data has been transferred.

When the EPROM has been programmed, the 68705 switches PB1 to a low, switching on TR8. This makes pin 12 of the DB25 connector low (bit 5 of the control byte), informing the computer that the 68705 has been programmed. As well, PB4 is pulsed low by the 68705, resetting the address counter (IC7), and PB0 is switched high turning on TR5. This turns off TR3, giving 5V to the Vpp terminal of the 68705. The next step is to check that the 68705 has been successfully programmed. This is done by the 68705 itself, which reads the data byte presented at port A by the RAM and comparing it to the data in the EPROM. The 68705 requests a new byte by sending a clock pulse out of PB3, as in the programming cycle. If the EPROM contents match the data in the RAM, a verified condition is signalled by making PB2 low. This output is buffered by TR7 and informs the computer that programming has been successful.

The computer then switches off the power to the programmer. Incidentally, the process to check if the internal EPROM is blank before programming is identical to this verify sequence, except the Vpp pin is held at 5V during the programming phase by turning TR4 on via IC6. Also the input to port A is held at $00. If the EPROM contains zero in all locations, a signal confirming this is sent to the computer.

PARTS LIST

Resistors

All 1/4W:

R1	1k
R2	100k
R3	470
R4	220k
R5,8,10-13,16,17-24	10k
R6	1 ohm
R7	180 ohm
R9	100 ohm
R14,15,25	4.7k

Capacitors

C1	100uF 16V electrolytic
C2,3,8-11,C14-16,18-20	0.1uF ceramic
C4,6,7,17,21	1uF 50V electrolytic
C5,12	100pF ceramic
C13	68pF ceramic
C22-24	10nF ceramic

Semiconductors

L1	Red LED
L2	Green LED
D1-4	1N4001 diode
Z1	12V 1/2W zener diode
Z2	22V 1/2W zener diode
TR1,3-5	BC547 NPN transistor
TR2	BD140 PNP transistor
TR6-8	BC557 PNP transistor
IC1,2	7805 3-terminal 5V regulator
IC3	78S40
IC4	6164 8K static RAM
IC5	74LS244 octal buffer
IC6	74LS273 8-bit latch
IC7	4040 CMOS counter
IC8	74LS32 quad OR

Miscellaneous

Silk-screened PCB coded OERP1, 200 x 90mm; 10mH inductor (I1); 1MHz crystal; 28-pin ZIF socket; 40-pin ZIF socket; DB25 plug, PCB mount; 3.5mm socket; 12V DC plugpack; 25 way cable; software disk; nuts, bolts; 4 x rubber feet

Kits of parts for this project are available from:
Oatley Electronics
5 Lansdowne Parade,
Oatley West, NSW 2223.
Phone (02) 579 4985
Postal address (mail orders):
PO Box 89, Oatley West NSW 2223.

Kit with all PCB components, silk-screened PCB and software disk	.........$230.00
12V DC plug pack	...$15.00
6805 microcomputer users manual	...$13.50
68705 microcomputer	... POA
Postage and packing	... $6.00

Construction

Construction of the programmer PCB should be straightforward, as the board is silk-screened. All components mount on the PCB and the only external connections apart from the DB25 cable are to a 12V DC power supply. A 200mA 12V DC plugpack is suitable. As usual, check the polarity of each component, and make sure you don't swap the two zener diodes. Z1 is a 12V zener, and Z2 a 22V device.

Also, check that you have the correct transistors for TR7 and TR8, as these are both PNP types. Apart from TR2, which is again a PNP type, all others are NPN type BC547.

Continued on page 93

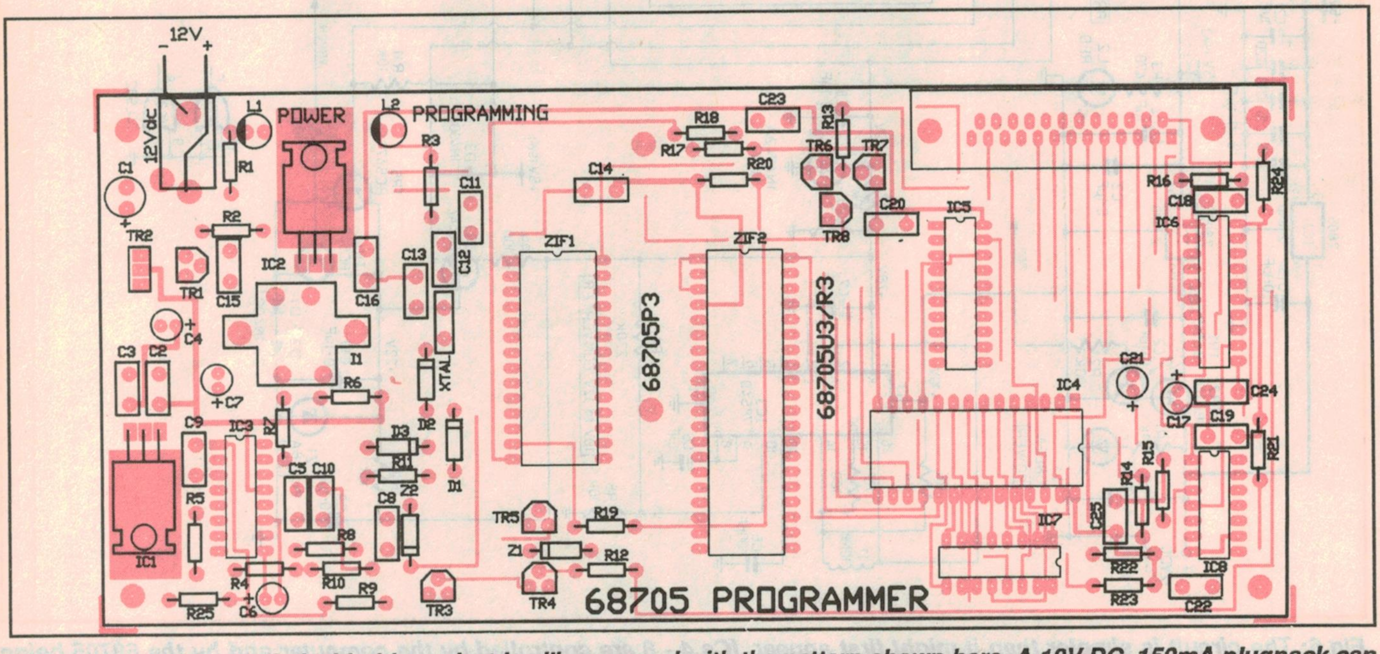


Fig.7: The board supplied with this project is silk-screened with the pattern shown here. A 12V DC, 150mA plugpack can be used to power the board.

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RMIT is now a university incorporating Philip Institute of Technology.

School of Electrotechnology
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GPO Box 2476V
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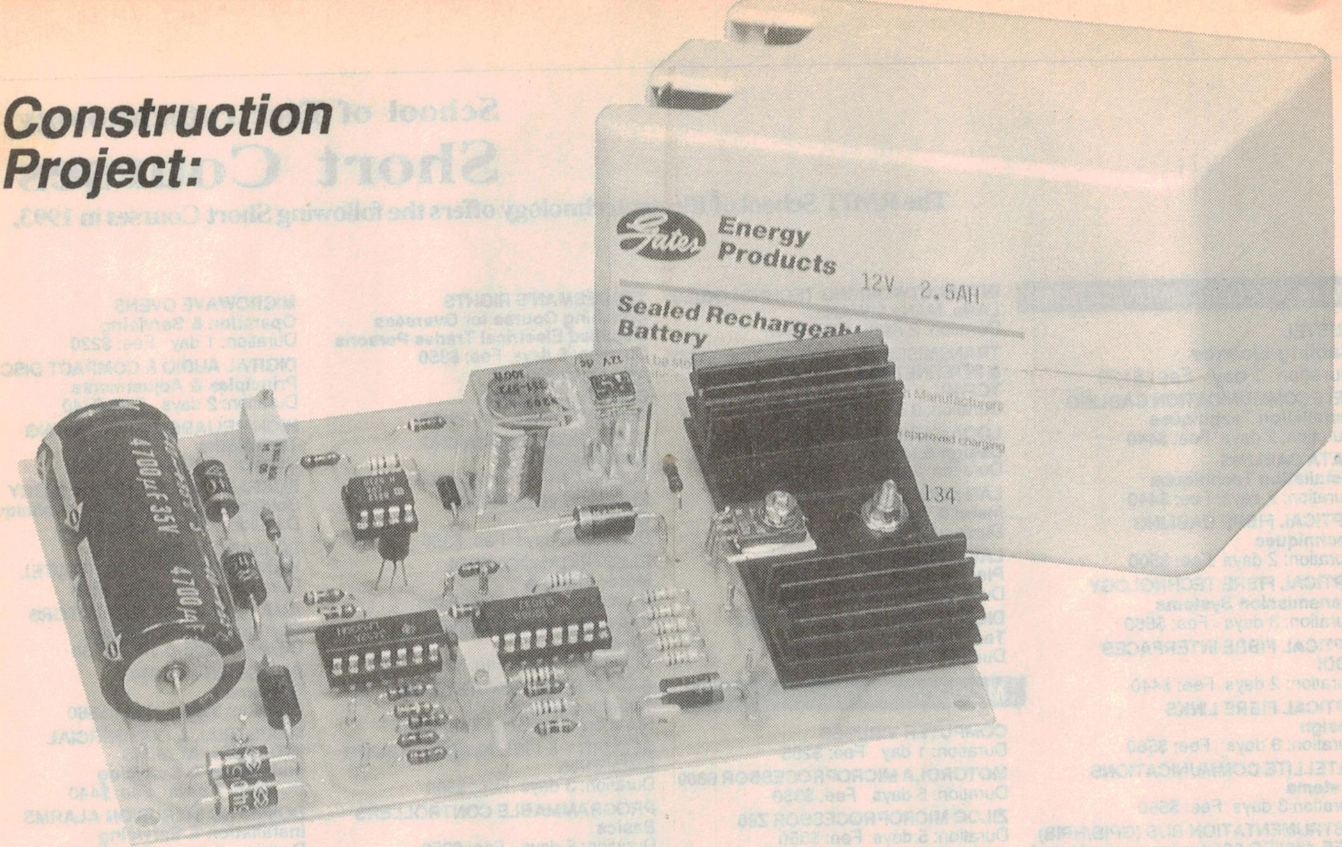
READER INFO NO. 16

RMIT

Construction Project:



Charger for 8V, 12V 'Gates' batteries

Here is a reliable 12 volt battery charger/supply circuit with the ability to charge various amp/hour capacity Gates sealed lead-acid cells. As well as being ideal for use in burglar alarm installations, the system can be easily adapted to replace some NiCad supplies in portable equipment such as video cameras — to give more 'run' time than original battery packs.

by MARK HURRY

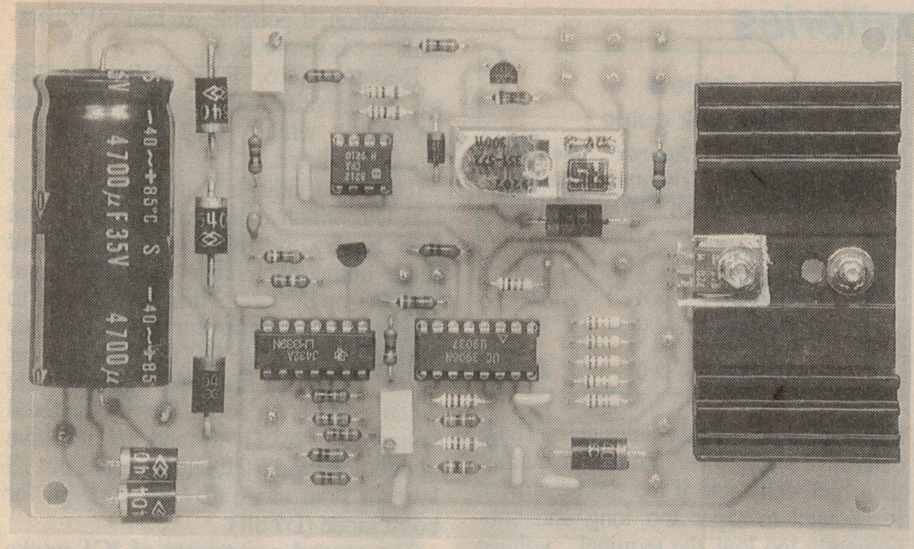
Although the construction of 'Gates' cells and their advantages was explained in detail in *Electronics Australia* November 1990, in the article 'An All Night Hi-Light', a brief re-cap is perhaps in order. Unlike 'flooded' lead-acid batteries such as a conventional car battery, Gates cells have a moist electrolyte solution which is wound up in a cylindrical roll with the active materials. The result is a cell with lower internal impedance and higher energy density than 'gel' type cells. The cells are also free from the 'memory effects' displayed by NiCad cells when they are only partially discharging and re-charging.

Gates batteries are available in various voltage and amp/hour configurations, some of which are housed in strong ABS plastic cases. Others are enclosed in strong plastic 'shrink wrap' with a rigid plastic extrusion on top for electrical and mechanical protection. Individual cells are also available which can be connected together with automotive type quick-connect connectors.

The charger circuit to be described is based on a UC3906 regulator IC, and can be configured to charge Gates 'D' (2.5 amp-hour), 'X' (5AH) or 'J' (12.5AH) cells in multiples of either four (8V) or six (12V). Although only these two voltages are described in this article, the charger can in fact be configured for other multiples of 2V. Tables 1 and 2 show the component values needed to configure the circuit for correct charging rate and desired voltage.

An optional, but very desirable low battery cut-out circuit has been included. This is because Gates cells *do* have a peculiarity of their own: if they are allowed to completely flatten — caused by leaving a load connected after the cells have discharged below 1.80V/cell, a significantly higher than normal charge voltage must be applied to enable them to accept charge again.

The 8V option is described because the charger and four Gates cells could be used to replace a 7.2V pack of NiCads. A fully charged set of four series Gates cells would have a no-load terminal voltage of approximately 8.8V. When connected to a load, such as a portable video camera/recorder, the terminal voltage would drop quickly to about 8.3 volts. As this is still higher than NiCads, you would have to find out your camera's maximum operating voltage before using this system.



A close up of the charger board, to guide you in wiring it up. Note that although sockets are shown here for the three ICs, these are optional.

A 6V configuration hasn't been described because some video cameras have a low battery voltage indicator and/or cut-out which would be set up for NiCad voltages. As a result it would tend to assume that a set of three Gates cells was 'flat', when it was still quite OK. This shouldn't be a problem if you are using an 8V pack of Gates cells, because an 8V set of these cells is considered fully discharged at about 7.4V, and a low voltage indicator/cut-out designed for a 7.2V NiCad battery pack will probably be set to operate in the region of 6V or so. As a result it will probably never trip.

The charger can be built into existing equipment or housed in a separate box with appropriate connectors. The unregulated DC input voltage VIN needs to be in the range of 18V (recommended minimum) to about 24V, or alternatively 12 - 18V AC can be fed into the rectifier bridge D1 - D4.

These voltages correspond to the 12 volt configuration; for the 8V configuration VIN can range from 12V up to 24V, so in this case there is the advantage of being able to charge the Gates pack from a 12V car battery.

Note that VIN should at no time exceed 35V DC. If a DC input is available, the rectifier diodes D1 - D4 can be omitted.

The circuit's current requirements will

	CELL SIZE		
	D	X	J
BOOST CURRENT	165mA	335mA	830mA
R5	1R5	1R5	0R22
R6	1R5	0R22	0R22
R7	1R5	0R22	0R22
R8	1R5	0R22	0R22
R9	1R5	N/U	0R22
R10	1R0	1R2	1R5
R11	N/U	1R2	0R22
R29	S	S	S
R30	S	S	S

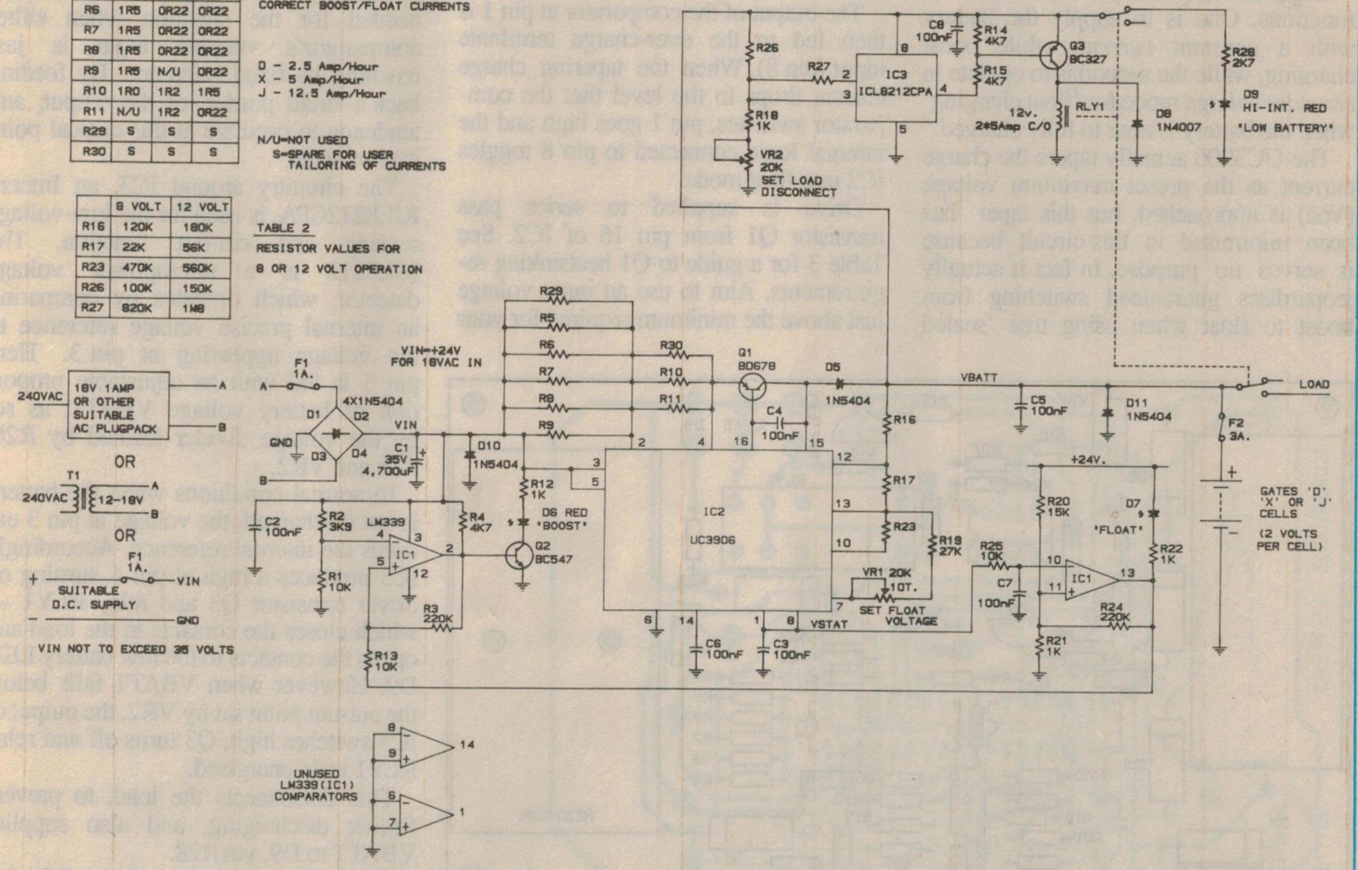
TABLE 1
RESISTOR VALUES FOR SETTING CORRECT BOOST/FLOAT CURRENTS

D - 2.5 Amp/Hour
X - 5 Amp/Hour
J - 12.5 Amp/Hour

N/U=NOT USED
S=SPARE FOR USER TAILORING OF CURRENTS

	8 VOLT	12 VOLT
R16	120K	180K
R17	22K	56K
R23	470K	560K
R26	100K	150K
R27	820K	1M8

TABLE 2
RESISTOR VALUES FOR 8 OR 12 VOLT OPERATION



Here is the complete schematic for the charger, showing the various options with regard to the power source. Tables 1 and 2 show the component values for setting the correct current levels for different sized batteries, and for batteries of either 8V or 12V. The circuitry associated with IC3 and Q3 is used to disconnect the load when the battery voltage drops too far.

depend on which size of Gates cells you are using. A 300mA supply should be used for 'D' cells, with a 500mA supply for 'X' cells and a 1A supply for 'J' cells.

Circuit Operation

The circuit is best understood by dividing it into four sections, performing the input, control, status indication and protection of battery and components.

The various possible applications for the charger/supply means that filter capacitor C1 is the only common component at the supply input. If the charger and Gates battery combination was to be used with a burglar alarm for example, AC would be supplied via transformer T1 or an AC plugpack to bridge rectifier D1-D4. The resultant full wave rectified voltage is then filtered by C1 and fed to the status indicator circuitry around IC1 and the charge circuitry around IC2.

If the charger is to be powered from an existing DC source such as a car battery (assuming the charger is configured for an 8V battery), T1 and D1 - D4 can be omitted and the DC input supplied directly to C1 via fuse F1.

Regulator chip IC2 performs two main functions. One is to supply the battery with a *constant current*, while boost charging, while the second is to operate in *constant voltage* mode for 'float charging' when the battery is near to fully charged.

The UC3906 actually tapers the charge current as the preset maximum voltage (Voc) is approached, but this taper has been minimised in this circuit because it serves no purpose. In fact it actually jeopardises guaranteed switching from boost to float when using true 'sealed lead-acid' cells such as Gates cells. These cells have much lower internal impedance than 'gel' cells, and if the charge current is allowed to taper too long and subsequently too low, the terminal voltage of the cells won't continue to increase. This means that the point at which switching from 'boost' to 'float' charging occurs (Voc) will never be reached.

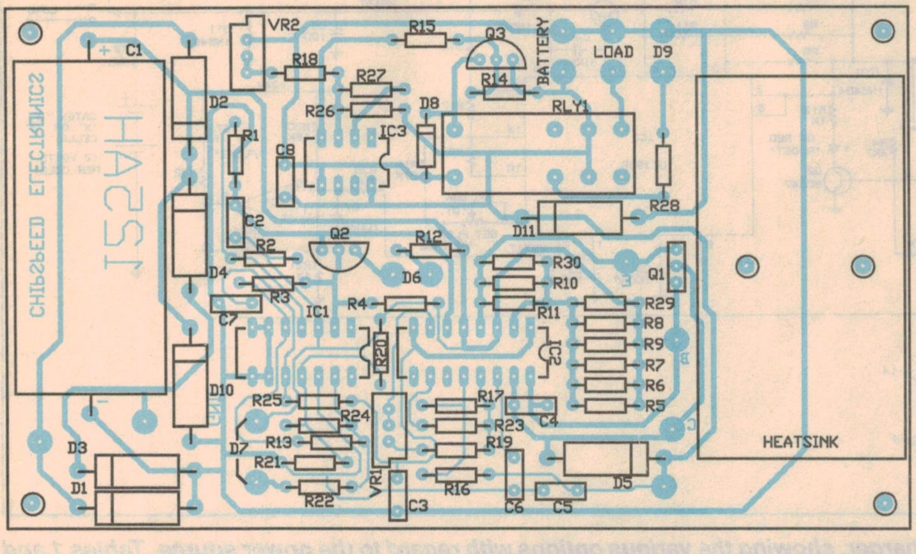
Table 3
Heatsink guide

Cell Type	Approx Heatsink Sink	Approx Thermal R(°C/W)	Max Vin for this Heatsink
D	60x32mm	6.8	24
X	60x32mm	6.8	16
X	63x100mm	4.0	24
J	63x100mm	4.0	16
J	Large metal area	2.0	24

In this case the charge tapering characteristic is minimised by making use of the current sense input of IC2. The total resistance between pins 2 and 4 of IC2 sets the charge current, and part of this is 'tapped off' and applied between pins 2 and 3 of IC2, the current sense comparator input.

The output of the comparator at pin 1 is then fed to the over-charge terminate input (pin 8). When the tapering charge current drops to the level that the comparator switches, pin 1 goes high and the internal logic connected to pin 8 toggles IC2 into float mode.

Drive is supplied to series pass transistor Q1 from pin 16 of IC2. See Table 3 for a guide to Q1 heatsinking requirements. Aim to use an input voltage just above the minimum required for your application, if possible, so that Q1's heatsink size is minimised.



Here is the PCB overlay diagram, to guide you further in wiring it up. Note that the series-pass transistor Q1 is bent over and mounted on the heatsink.

Resistors R16, R17, R19 and R23 set the approximate charge and float voltages, while RV1 provides a final adjustment.

The status indicators are LED's D6, D7 and D9, which indicate boost, float and low battery respectively. The current sense output/overcharge terminate input (VSTAT on the circuit diagram) is used to drive the first comparator of IC1 (pin 10) via R25 and C7. VSTAT is either low for boost or high for float. IC1 compares the voltage appearing at pin 10 with the fixed voltage at pin 11 formed by resistive divider R20 and R21, and switches pin 13 low for float mode (D7 on) or high for boost mode (D7 off).

The second comparator of IC1 works similarly to the first. Output from pin 13 of the first comparator is fed to pin 5 via R13, and is compared with a fixed voltage at pin 4. Output from pin 2 then turns Q2 and thus D6 on or off. Because the output of the first comparator controls the second comparator, either D6 or D7 (not both) can be illuminated at any one time.

Resistors R24 and R3 provide positive feedback, which ensures quick clean switching of both comparators. This is needed for the situation when either comparator's variable input is just reaching its fixed reference. By feeding back a small portion of the output, any tendency to oscillate at this critical point is eliminated.

The circuitry around IC3, an Intersil ICL8212CPA, is used for the low-voltage sensing and cut-out function. The ICL8212 is a micropower voltage detector, which operates by comparing an internal precise voltage reference to the voltage appearing at pin 3. Here pin 3 is fed with an adjustable proportion of battery voltage VBATT, as set by the voltage divider formed by R26, R18 and VR2.

In normal conditions when the battery is not discharged, the voltage at pin 3 exceeds the internal reference. Accordingly IC3 produces a high at pin 4, turning on driver transistor Q3 and relay RLY1 — which closes the contacts to the load and opens the contacts to the low battery LED D9. However when VBATT falls below the cut-out point set by VR2, the output of IC3 switches high, Q3 turns off and relay RLY1 is de-energised.

This disconnects the load, to prevent further discharging, and also supplies VBATT to D9, via R28.

To minimise battery drain by D9 after the load has been disconnected, D9 is specified as a high intensity LED so that a useable indication is obtained for only a

couple of milliamps current drain. Unless D9 is going to be noticed and action taken to re-charge the battery, it could actually be omitted along with R28.

As the comparator inside IC3 begins to switch, it provides positive feedback out of pin 2. This is fed back to pin 3 using R27, again to ensure clean switching. The feedback also produces useful hysteresis, the amount of which is determined by the value of R27.

For example, consider that the low voltage cut-out is set at 11.2V for a 12V battery, and the battery volts have just dropped to 11.2V. After RLY1 has de-energised and the battery is disconnected from the load, the battery volts will tend to 'spring' up slightly, because the load has been removed. If there was no hysteresis, RLY1 would then re-energise — causing a drop in battery volts again. This scenario would be continually repeated, until either the battery was discharged to the point where it couldn't energise RLY1 or the relay failed from the continual 'chattering'.

In reality, the hysteresis produced by the positive feedback via R27 will raise the re-energising point of RLY1 to approximately 12.0 volts, which means some re-charging of the battery must have occurred for this point to be reached. Hence 'chattering' is avoided.

Reverse polarity protection diode D10 is optional and can be omitted if there is no possibility of VIN being connected in reverse — e.g., in a fixed burglar alarm installation. If an external DC supply is to be used, connect it via a 3A fuse to Vin to ensure that when D10 conducts in the event of reversed polarity, the fuse can provide protection against damage.

D11 is also optional, but is desirable because it protects the circuit against reverse connection of the Gates battery. D5 *must* be used, because it prevents the battery discharging into the circuit and possibly damaging it when VIN is not present.

Fuse F1 is used for supply input protection and should be reduced in value to one amp when using 'D' or 'X' cells. F2 acts as a weak link for D11, to 'blow' if the battery is mistakenly connected in reverse. F2 also provides protection for the wiring in case of a short circuited load being connected across the battery.

Gates cells are capable of very high short circuit currents because of their very low internal impedance. A short circuit across them could easily melt any associated wiring. If you are using 'J' cells, D11 should be changed to at least a 10A stud-mounting diode mounted off the PCB somewhere. F2 may need to be changed to a 5A or 10A fuse in this case, depending on the type of load.

PARTS LIST

Basic charger

Semiconductors

IC1	LM339 quad comparator
IC2	UC3906 regulator
Q1	BD678 or BD680 PNP power
Q2	BC547 NPN
D5	1N5404 power diode
D6	Red LED
D7	Green LED

Capacitors

C1	4700uF 35VW electrolytic
C2-7	0.1uF monolithic ceramic

Resistors

(All fixed resistors 0.5W metal film)

R1,13,25	10k
R2	3.9k
R3,24	220k
R4	4.7k
R5-11	See Table 1
R12,21,22	1k
R16,17	See Table 2
R19	27k
R20	15k
R23	See Table 2
VR1	20k 10 turn vertical trimpot

Miscellaneous

PCB, 147 x 97mm, coded 125AH; nine x PCB/matrix board pins; TO-220 mounting kit, with heatsink as selected from Table 3; four PCB mounting pillars; Gates battery, to suit application; 18V AC plugpack or suitable supply.

Options

Semiconductors

IC3	ICL8212CPA micropower voltage sensor
Q3	BC327 PNP
D1-4	1N5404 or 1N4007 (see text)
D8	1N4007
D9	High intensity red LED
D10,11	1N5404 power diode

Capacitors

C8	0.1uF monolithic ceramic

Resistors

(All fixed resistors 0.5W metal film)

R14,15	4.7k
R18	1k
R26,27	See Table 2
R28	2.7k
VR2	20k 10 turn vertical trimpot

Miscellaneous

8-pin IC socket; 14-pin IC socket; 16-pin IC socket; four PCB or matrix board pins; 12V relay with two sets of 5A changeover contacts (RLY1); fuses and fuseholders.

The PCB, basic kit and individual parts used in this project are available from Chipspeed Electronics, PO Box 38, Casula Mall NSW 2170.

The PCB cost is $14.50 plus $2.00 for postage. The basic kit cost is $37.00, plus $3.00 postage in the Sydney area or $4.00 postage for anywhere else in Australia.

For all inquiries regarding individual components, including Gates cells and battery packs, send a 220 x 110mm SAE to Chipspeed Electronics at the above address.

Construction

Mount the components you need for your application on the PCB as shown on the component overlay. Make doubly sure that polarised components are orientated correctly. IC sockets aren't essential, but can make future servicing (if needed) much easier.

The connections to the PCB are made via push-fit 1.4mm diameter solder pins, such as matrix board pins. Just push the short end of the pin into the hole from the top of the PCB with small pliers, solder the pin to the copper pad and snip the excess off the bottom. The PCB is wide enough to fit a 63mm wide heatsink. A 32mm long heatsink will fit neatly on the PCB for low power applications. A 100 x 63mm (4°C/watt) heatsink is adequate for medium power applications.

Position the heatsink you are goingto use on the PCB, and mark the location of Q1's mounting hole on the heatsink through the 4mm hole in the PCB. Then centre-punch the heatsink at the mark you have made, and drill a 1.5mm pilot hole in the heatsink. Finish off with a 4mm drill, which will result in a hole just right for the usual insulating bush. When mounting Q1 on the heatsink, use a TO-220 mounting kit and also heatsink compound, if you are a using mica washer.

Use the 3mm hole adjacent to Q1's mounting hole to mark and drill an extra hole, for stabilising with a nut and bolt any heatsink which may overhang the end of the PCB. If you use the 63 x 32mm (6.8°C/W) heatsink, ignore the existing hole in the heatsink and mark and drill Q1's mounting hole so that the long edge of the heatsink is flush with the edge of the PCB.

For high power use, three PCB pads for solder pins have been provided to run connecting wires to transistor Q1, which can be mounted on an external heatsink or chassis.

Setup and testing

When two voltages are shown one after the other in these notes, the first one is for the 12 volt option and the second in parenthesis is for the eight volt option.

Once all the necessary components are mounted on the PCB, connect the charging supply via fuse F1, the Gates battery via fuse F2 and switch on. LED D6 should come on, indicating that the battery is being boost charged.

While measuring the voltage directly across the battery, observe that the voltage steadily increases. Adjust VR1 so that the voltage doesn't exceed 15.0V

(10.0V). Once the charge current is tapering, this high point voltage won't change much but the charge current will steadily decrease.

After the charger has switched from boost to float (D6 off, D7 on), continue to monitor the voltage for a few hours (to allow the float current to drop right down) and finally adjust VR1 so that the battery voltage is 14.1V (9.4V).

If you aren't installing the low battery cut-out option, cycle the battery as described shortly and re-check the final float voltage after the battery has fully recharged. To set up the low battery cut-out circuitry, begin by switching off the charger. Refer to the section on cycling, and start discharging the battery with a suitable discharge resistor connected from LOAD as shown on the circuit diagram to common (GND).

With a C/10 discharge resistor, the low battery cut-out point will be reached after about 9 hours. Monitor the voltage across the battery, and when 11.2V (7.4V) is reached, adjust VR2 so that the relay de-energises and D9 illuminates. VR2 may need initial adjustment so that D9 doesn't illuminate prematurely.

Now remove the discharge resistor and switch on the charger. Observe that the relay energises at approximately 11.95V (7.95V), turning off D9. Switch off the input to the charger and connect the discharge resistor again. Re-check that the low battery cut-out point is correct, then remove the discharge resistor and allow the battery to fully charge.

After about 15 hours, the charger should switch from boost to float. Then after another couple of hours of being on float, re-check that the float voltage is correct and adjust if necessary. Your charger should now be ready to go into service.

Battery cycling

New Gates cells are generally delivered with about 80% of rated capacity. To maximise the storage capacity, it is necessary to *cycle* the cells.

Cycling is achieved by discharging the cells at the C/10 rate until each cell voltage falls to approximately 1.85V, and then re-charging. This process should be repeated several times. Cycling can be employed at any time in a cell's life to maximise its capacity.

In practice, make sure that no cell's voltage ever goes below 1.80V. If you are discharging a multi-cell battery, during either cycling or normal use, terminate the discharge when the lowest cell voltage reaches 1.85V.

If Gates cells are allowed to be excessively discharged — i.e., absolutely flattened — they will need to be specially charged with a much higher than normal voltage to enable them to accept charge again. This is why it is a good idea to use the low-battery cut-out option.

To calculate the C/10 discharge resistor required for cycling, use the following formula:

R = (V*10)/C

where C = amp-hour capacity of the cell(s)
e.g., C = 5 for 'X' cells; and
V = voltage of the battery being discharged

For example, the C/10 discharge resistor required for a 6V 'D' cell battery pack would be:

R = (6*10)/2.5 = 24 ohms

Here you would use the next highest standard value of 27 ohms. The power rating needed is given by V^2/R, so here it would be 36/27 or 1.33W. In this case you would use a commonly available 5W type — and be careful, it will get HOT!

Special precautions

Finally, an important safety note. Gates cells produce a small amount of hydrogen while they are being charged. Therefore the cells must be mounted in an enclosure which is suitably ventilated, to prevent a dangerous buildup of gas. ❖

COMING NEXT MONTH IN EA:

PROGRAMMABLE DOOR CHIME

A new low cost design using easily available IC's, which can be programmed to play just about any desired simple tune simply by fitting diode 'links'. Notes can be doubled in length for emphasis, and 'rests' can be used to provide a more realistic rhythm. You can even program it so the back door button plays a different tune, or part of the main tune!

LOW COST 1GHZ FREQUENCY COUNTER

An easy to build 'big brother' version of the 50MHz design published in our February issue. As well as offering counting up to 1GHz, it also provides greater resolution — seven digits instead of only four. Despite these enhancements it should only cost you about $165 to build, making it probably the cheapest 1GHz counter design ever...

ALL THESE AND MORE IN NEXT MONTH'S ISSUE, DUE ON SALE MARCH 24!

Frequency synthesis using the PLL

The phase-locked loop or PLL is an excellent method of synthesising one or many different frequencies, all of which then possess the stability and/or other attributes of a single reference frequency. This scheme is widely used in today's radio transmitters and receivers. This month we look at the basics of frequency synthesis.

by BRYAN MAHER

The term *frequency synthesis* basically means any method of producing a desired frequency signal by combining a reference frequency and a control signal to produce another frequency. Synthesisers are used widely in transmitters and receivers to generate any one of a wide range of very stable frequencies.

In transmitting applications, you might want to generate a carrier for any one of the nominated CB channels. Receiver design may call for a local oscillator frequency to be digitally controlled, to cover the entire band.

In every case the signal produced is required to be of known and very stable frequency.

Crystals and VFO's

In a fixed-frequency AM transmitter, the generation of accurate carrier frequency is no problem. You just set up a crystal controlled oscillator, as we have seen earlier in this series.

Any crystal oscillates at a fixed frequency, on either its fundamental or one of its low harmonics, depending on the circuit.

Some transmitters are required to transmit on any nominated frequency within a well defined band, as for example an amateur 'rig'. For this, some use a *variable-frequency oscillator* or VFO, which is the simplest but least stable solution. These circuits use variable-tuned LC circuits to determine the frequency, and the slightest change in ambient conditions can cause frequency drift.

Whether the circuit is to generate a variable frequency transmitter carrier or the local oscillator of a superhetrodyne receiver, the requirements are much the same. The ideal would be:

1. To generate any frequency we choose, which can be varied in large, small or infinitesimal increments.
2. To accurately know the frequency of oscillation, perhaps displayed on a digital readout.
3. Each frequency chosen should have rock-steady stability.

The Greek origin of the word 'synthesis' is almost a parallel to the electronic circuit we use. A *thesis* means an idea or proposition put forward, while *antithesis* means an opposing idea. Originally *synthesis* was a philosophical term, meaning a union of thesis and antithesis in order to extract the best of both.

In the electronic circuit we input two things: an accurate reference frequency and a control signal, and from them we extract any desired frequency which has the stability of the reference input. So we take the best of both...

The reference is usually a crystal controlled oscillator. The control signal input is commonly a parallel digital word — a group of four, six, eight or more bits.

There are basically two kinds of frequency synthesis in current use. *Direct frequency synthesis* uses a sampling/reconstruction technique, which we will leave until a later chapter. *Indirect frequency synthesis uses that IC of a thousand uses, the ubiquitous phase-locked loop or PLL.*

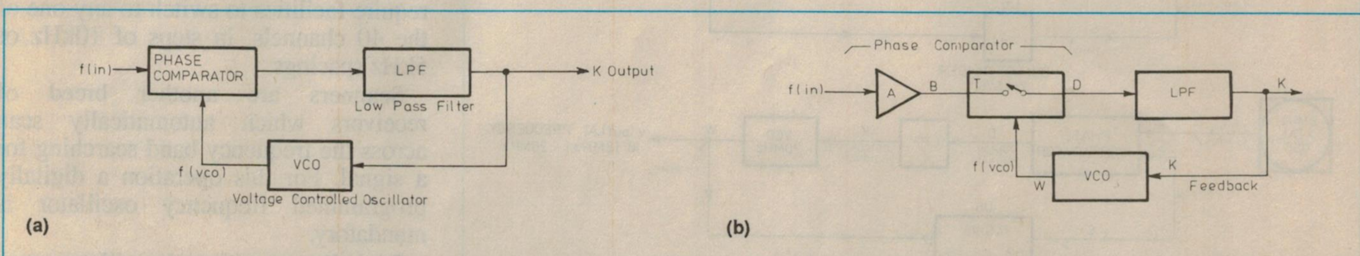


Fig.1(a): Basic phase-locked loop (PLL) circuit. The input reference frequency f(in) is compared in the phase comparator with f(vco), the output of the voltage controlled oscillator. The error signal output from the phase comparator represents any difference in frequency or phase between the two. This error signal is filtered and used to control the VCO's frequency.

Fig.1(b): Functional representation of a PLL. The signal f(vco) switches the output of amplifier A on and off. The feedback from the low pass filter (LPF) at K controls the frequency of f(vco), forcing it to become equal to f(in).

Basics of Radio - 18

PLL revisited

To prompt our memory, Fig.1(a) and (b) from the last episode are repeated to show the fundamental block diagram of the PLL. Recall that when it is in the locked condition, the loop feedback keeps the voltage controlled oscillator (VCO) running at exactly the same frequency as f(in).

Now let's play around with the circuit a little and see where it leads us. Start with a crystal controlled input signal v(in), which is so stable that we will often call it a *reference* frequency.

In Fig.2 we have inserted an extra component U6, a simple divide-by-4 digital IC, (two cascaded flipflops) in the feedback loop path.

Readers will of course recall that whereas v(in) could be a square or sinewave, the VCO voltage is almost always a square wave. So a TTL or other digital IC fits well into the circuit. Also we will take output from the VCO at W.

In Fig.2(a), as long as the system is in lock condition, the loop feedback action must keep the signals at S and P at exactly the same frequency.

Now because of the presence of the divider U6, the VCO signal at W is *four times* the frequency of the divider output at S. (That's elementary, you are no doubt saying!) But that of course means that the VCO output at W is precisely four times the frequency of v(in) at P.

Therefore, because v(in) is derived from an accurate stable crystal oscillator, the VCO frequency at W must be just as stable, only it is four times higher in frequency than the crystal. For example if the crystal oscillator in Fig.2(a) is running at 2MHz, then the output from W will be a digital signal at 8MHz.

So we have generated a second frequency, which depends for its stability on that of the first (or reference) signal. This is the charm of PLL frequency synthesis.

Recall now from the last episode that the feedback loop signal into the phase detector (at S in Fig.2(a)) must be a square wave having 50% duty cycle.

The output signal from the divider U6 will satisfy this requirement, which is accomplished by the cascaded divide-by-two ICs.

Other division ratios

Now let's change U6 to a different integrated circuit, one which can divide by some other number which we will call N. If we desire N = 10, we could use any suitable divide-by-ten counter in the position U6 in Fig.2(b). Say we use a TTL integrated circuit 74S196.

To satisfy the requirement that the output of the divider U6 be a square wave having 50% duty cycle, we connect the 74S196 as a *bi-quinary* 5-2 counter (not as a decade 2-5). This means the signal from the VCO is first divided by five, and then by two. The final division by two gives the needed 50% duty cycle.

Again, the output of the divider at S must be 2MHz (as long as the PLL system is in lock). And as the input to the divider is a frequency 10 times higher than its output, the output of the VCO at W will now be a signal v(out) at a highly stable frequency 10 times greater than the 2MHz crystal.

So we have created a new frequency at 20MHz, which has the stability characteristics of the old 2MHz signal. The idea has endless possibilities...

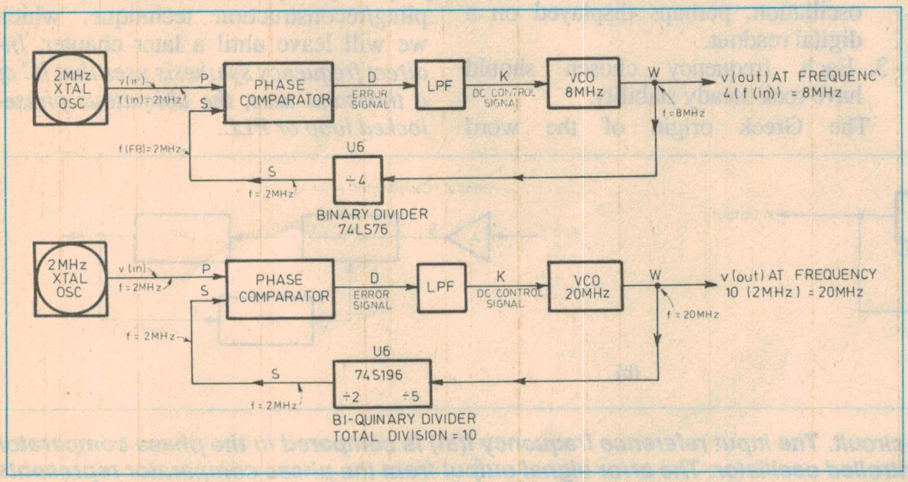


Fig.2: By placing a frequency divider U6 inside the PLL feedback loop, the VCO must generate a higher frequency than is applied to the phase detector at S. Therefore the VCO frequency becomes some multiple of the crystal reference, but just as stable.

IC frequency limits

Naturally we always must use integrated circuits which can operate correctly at the frequency used. If in Fig.2 the reference crystal frequency f(in) is 2MHz, then the phase comparator must be capable of responding at that frequency.

In the popular NE series of IC's originated by Signetics, the PLL type NE565 will not work above 500kHz, so it could not be used in Fig.2(a) and (b). However the NE561 or NE560B would be fine, as their upper frequency limit is 30MHz.

This top frequency capability of an IC depends on the chip design, the stray interelectrode capacitances and the bandwidth capabilities of the integrated transistors. For high frequency operation you must also obey the usual rules of VHF working — i.e. short leads, generous supply bypassing, an earthed ground plane at the back of the printed circuit board, avoidance of crosstalk and use of low inductance fast ceramic capacitors for decoupling and bypassing.

If in Fig.2(a), U6 is a dual JK flipflop with feedback connected to give division by 4, then the VCO frequency will be 4(f(reference)) = 8MHz. For the divider a 74LS76 (dual JK flipflop) would be fine (f(max) above 30MHz). However if we change U6 in Fig.2(b) to a divide-by-10, then the VCO and the divider U6 will both have to work at 10 x 2MHz = 20MHz! For this use U6 could be one of the fast TTL bi-quinary counters like the 74196 or 74S196 (f(max) = 25 or 50MHz).

Digital programming

A digitally-programmed frequency source is required by many high class variable-frequency transmitters and receivers. The digital readout of frequency then becomes a meaningful and very useful adjunct. As well, multi-channel CB transceivers and the like require facilities to switch to any one of the 40 channels, in steps of 10kHz or 5kHz spacings.

Scanners are another breed of receivers which automatically scan across the frequency band searching for a signal. For this operation a digitally programmed frequency oscillator is mandatory.

Digitally-programmed oscillators cannot make infinitely small changes in the frequency, as is done in variable LC-tuned circuits. But smooth operation can be approximated by digitally changing the frequency in a very large number of extremely small steps.

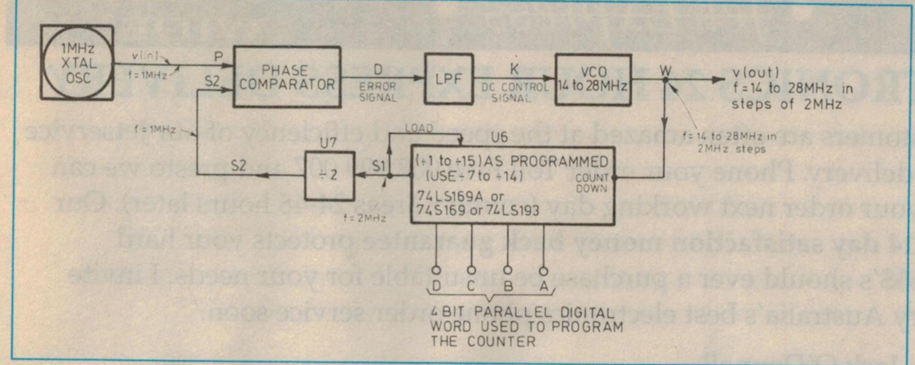


Fig.3: By using a programmable divider for U6, we can control the frequency of the VCO at W over a wide range. This is the essence of PLL frequency synthesis. The divide-by-two stage U7 is necessary to give the feedback signal at S2 a 50% duty cycle as required by the phase detector.

To investigate digital programming of frequency, let us start in Fig.3 with an easy hypothetical example. Say a 1MHz crystal is to be used as reference, and from this many higher frequencies are to be synthesized — the frequency being required to change to only eight different values, in coarse 2MHz steps. That will show us how it all works. Later, to cause the frequency to change in thousands of extremely fine increments will only require an extension of the same principles.

We start by investigating a scheme using a simple programmable divider for U6 as in Fig.3. The TTL integrated circuits 74LS169A or 74LS193 are synchronous four-bit up/down binary counters, which can be programmed to give division by any integer between 1 and 16.

Programming is achieved by applying a binary four-bit digital word to the four program inputs A, B, C and D during a Load pulse; the counter state is thereby set up to the value of that digital word.

(Remember that in digital electronics, a 'bit' is the smallest quantity of information carried by voltages. Digital voltage levels are discrete, meaning the voltage is either high (on) or low (off). Information is carried by whether the voltage is on or off, not by its precise value. A 'word' is some convenient group of bits, in this case four. In this application the four bits are carried by the four parallel conductors A, B, C and D.)

The output frequency of the VCO which is to be counted is then connected to the clock input of the counter. The counter then counts down from the set value to zero, when an output pulse is generated. The process then repeats.

The digital word will represent the number by which we wish to divide. A is the *least significant* bit (LSB), and is D the *most significant* bit (MSB). The counter divides the VCO frequency by whatever number is represented by the input binary word.

To refresh your memory, the four-bit binary code extends from 0 to 15, (i.e., 16 steps) as shown in Table 1. Each bit is attributed a value or 'weighting' which is some power of 2. Remember from mathematics that $2^0 = 1$, $2^1 = 2$, $2^2 = 4$, $2^3 = 8$ and so on.

For example if the input binary word is to represent the decimal number 7, then binary regards this as $(4 + 2 + 1) = 2^2 + 2^1 + 2^0$. Or if we wish to divide by 13, then binary sees this as $8 + 4 + 1 = 2^3 + 2^2 + 2^0$.

To generalise, $7 = 0 + 4 + 2 + 1$
and $13 = 8 + 4 + 0 + 1$

To connect a binary word meaning the numerical value 13 to the counter data input terminals, we would therefore need to input a '1' bit to input D (1×2^3), a '1' bit to input C (1×2^2), a '0' bit to input B (0×2^1) and a '1' bit to input A (1×2^0).

In the real electronic circuit, where these inputs are input terminals of the counter chip, this means that we will need to apply a TTL 'high' voltage level to pins D, C and A, and a TTL 'low' voltage level to input pin B. This is to program it for division by 13, don't forget.

TABLE 1: The four-bit binary code

Decimal value	D (msb) 2^3 (8)	C 2^2 (4)	B 2^1 (2)	A (lsb) 2^0 (1)
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H
10	H	L	H	L
11	H	L	H	H
12	H	H	L	L
13	H	H	L	H
14	H	H	H	L
15	H	H	H	H

Table 1 shows the four-bit binary code representation of all the integers 0 through 15. In the table L means that a low voltage corresponding to a logic zero or OFF should be applied to that pin of the counter. H means that a high voltage corresponding to logic 1 or ON should be applied to that pin.

With TTL devices, an input zero or low (L) means a voltage anywhere in the range from zero volts to +0.8 volts. A TTL input 1 or high (H) means a voltage anywhere between +3V and +4.5 volts.

These voltages will be automatically at the correct levels if the digital program signal comes from some other TTL device output. (Any device used to drive a TTL IC must be capable of both sourcing and sinking current.)

In Fig.3, remember that the loop feedback signal applied to the phase detector at S2 must have 50% duty cycle. Unfortunately the programmable divider output at S1 does not have this characteristic. Therefore we follow the programmable counter with a simple divide-by-two stage made from a - type flipflop.

That means that the overall division from W to S2 effectively can be programmed from N = 2 to N = 32. The frequency f(S2) of the combined divider output at S2 is related to the VCO frequency f(vco) at W by the equation:

f(S2) = f(vco)/N, or
f(vco) = N.f(S2)

Where N is twice the numerical value of the programming digital word applied to the counter's A, B, C and D input terminals.

As long as the phase-locked loop is in the lock condition, f(S2) must be the same as the crystal oscillator frequency; in this example 1.0MHz. Therefore

f(out) = f(W) = f(vco) = N x 1.0MHz.

Higher frequencies

By programming the counter with any number between 1 and 15, we can make the divisor/multiplier factor N take any even value from 2 to 30.

Using the 1.0MHz crystal as reference frequency, we could in principle therefore produce output frequencies at W having any one of the values 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28 or 30MHz.

Changing the output frequency at W is
Continued on page 93

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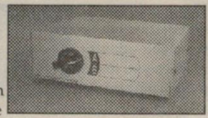
A-B Switch Box D25-D25



Two way printer-peripheral-computer switch with D25 female sockets. Allows two printers to be run off one computer and individually selected or allows one printer to be run off two computers and individually selected.

D 1570 Normally $49^{.95}

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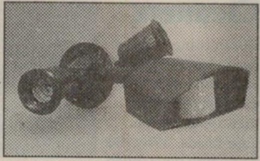
Passive Infra-Red Lite Aide Floodlight Control

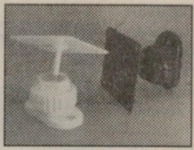
S 5350 **$49^{.95}**



How often have you thought there could be a prowler outside your door? Install a Lite Aide and (once armed) any "guest" will be floodlit when detected by this highly sensitive Infra-Red Detector

The Light Aide detects a moving person or vehicle by comparing the background temperature with a rapid change of temperature across the detection beams. So when Lite Aide detects movement across the coverage area, it will turn on the floodlight(s) for 10 seconds to 15 minutes as pre-adjusted.

Universal Swivel Wacki Bracket



Costing up to 60% less than inferior imported products. This Australian designed and manufactured bracket has a multitude of uses. Ideal for mounting speakers, strobe lights, security lights, CCTV cameras etc, in fact the uses are as wide as one's imagination. The unique design allows up to 500 angle variation either vertically or horizontally.

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Screw-on Fittings Include: • 4 x Croc Clips • 2 x Fork Connectors • 2 x Pin Plugs • 2 x Hand Probes • 4 x Banana Plugs

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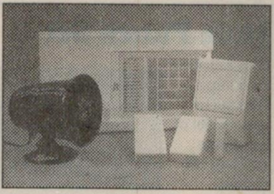

Apart from the flawless operation of the system one of the great features is its application with rented or leased premises - let's face it, money spent on installing a wired system in your home or office, factory, etc is irrevocably lost when you move on. With this system you simply take it with you.

Complete system includes:

1 x Control Panel 1 x Passive Infra Red Detector-Transmitter 1 x Door-Window reed Switch-Transmitter 1 x Hand Held remote Control-Transmitter 1 x Horn Speaker - 10 watt-wired 1 x 240V AC adaptor 1 x 1.2Ah Back-up Battery 1 x Set of batteries for all transmitters

S 5240 Complete System Price Only **$679^{.00}**

Stereo 60 Watt 8 Ohm Attenuator

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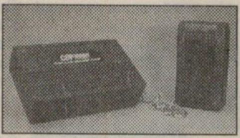

Compatible with virtually all alarm systems on the market, this device simply connects to the output of your alarm. If it sounds it automatically transmits a signal to the pocket pager which alerts you that your car is being tampered with. It has a range of over 1 km in ideal conditions. Gives extra peace of mind when your away from your car. Ideally suits Altronics alarms S 5220 and S 5230.

Features: • Compatible with most alarms • Complete with transmitter and receiver (pocket pager) • Easy to install • 1000 security codes

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Kit Contents:

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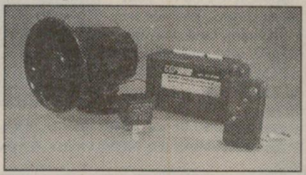

Other features include starter inhibit, valet mode, central locking interface, flashes car indicators when tripped, auto reset, user programmable options plus much more.

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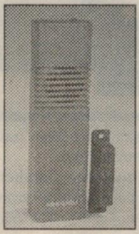
Door Alarms



With this simple device you can monitor any door in your house. This two piece alarm consists of a control box and a magnet. The magnet simply onto the door frame while the control box is mounted on the door, so that they are opposite when the door is closed. Easy to use on/off switch. Built-in beeping buzzer sounds when tripped. Requires 9V battery.

S 5315 NORMALLY $19^{.95}

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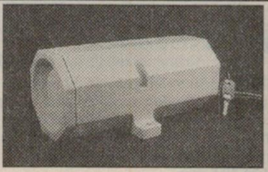
Satellite Siren



Connects easily into most car or house alarm systems.

This self contained compact unit delivers a massive 120dB of deafening sound pressure once activated. It connects simply via 3 wires to any alarm system (car or house) that has an output that is normally negative (or low). When the alarm system is activated and the output goes positive (or high) the siren will sound. The siren will also operate if the wires to it are cut. Hence it adds extra security to your system if someone tampers with it to disable it. Simply armed and disarmed via inbuilt key switch.

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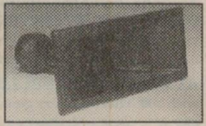
Motorola KSN1151A/1142A



Horn part no. KSN1151A, driver part no. KSN1142A. Piezo Horn speaker suited to Hi Fi, PA and sound reinforcement. With built-in protection.

Dimensions:....................265 x 110mm
Frequency Response:....1.8kHz - 30kHz
SPL:..................................92dB (2.83V/1m)
Rated Power Input:.......75w nom, 400w max

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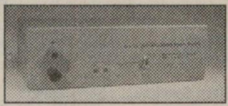
13.8V 1A UPS



Designed for critical applications where it is important that products remain operational during mains failure, this UPS (Uninterruptible Power Supply) will supply 12V at 1.2 Amps via its internal inbuilt sealed lead acid battery even when the mains has failed. Ideal for use with alarm systems etc.

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Rated Power.....30W RMS
Impedance........8 ohm
RES Frequency .65Hz
Sensitivity 97dB/W (0.5m)

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De-Solders with an easy squeeze!

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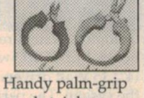

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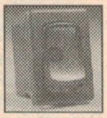

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ALTRONIC COMPONENTS

Basics of Radio - 18

Continued from page 89

only a matter of changing the value of the four-bit digital word presented to the counter input terminals A, B, C and D. In many applications a computer or microprocessor will be used for this control function.

VCO range

All of this presupposes that the PLL remains in lock, of course, and this in turn assumes that our VCO can be 'pulled' to the frequencies where it needs to be oscillating, to produce locking.

The normal frequency span of a VCO without change of the RC components is about an octave (i.e., a change from one frequency to twice that value).

The range 2MHz to 28MHz contains nearly four octaves: 2 to 4MHz; 4 to 8MHz; 8 to 16MHz and 16 to 32MHz. So in practice, this wouldn't really be feasible. For simplicity we would therefore need to confine ourselves to producing frequencies in a single octave, say from 14MHz to 28MHz.

That means our demonstration synthesiser in Fig.3, using one crystal at 1.0MHz, would still be able to produce any one of eight frequencies: 14, 16, 18, 20, 22, 24, 26 or 28MHz. And each of these will have the stability attributes of the reference 1.0MHz crystal.

Speed limits

All of these frequencies are within the range of the counters mentioned (32 and 35MHz) and of the VCO in the NE561 (30MHz). Note that although the VCO must also be capable of running at 28MHz, the phase detector in this case runs casually along at 1.0MHz. We will take up these vital speed considerations again in the next episode.

By extending the basic principle described in this chapter, we could make the phase-locked loop system produce thousands of different frequencies in very very small steps.

As well, by causing the programming digital word to range through all possible values, we could make the output frequency scan across the whole frequency spectrum — as needed by a scanner. By using an FM modulated reference signal we can also achieve lots of other fascinating things.

But these ideas will have to wait until a further episode, so if you're still with me, take a well-earned break. ❖

PC-based 68705

Continued from page 80

Once construction is complete, inspect the circuit board for any soldering faults, especially around the ZIF sockets where the tracks are closely spaced and run between the IC pins. A DB25 cable is required to connect the programmer to the computer. Each terminal of both connectors has corresponding pins connected to each other (pin 1 to pin 1 etc).

Programming tips

The kit includes a disk which contains a program called PROGRAM.EXE, which is used to drive the 68705 programmer. This disk also contains the Motorola freeware cross-assembler (AS5_NEW.EXE), the simulator (SIM.EXE) and some sample programs written in 6805 assembly language to get you started. Text files describing each program are also included. Note that the freeware files are distributed free of charge.

Prior to programming the 68705, it should be erased with a standard EPROM eraser. Don't use a 'blacklight' UV tube, as these produce the wrong wavelength UV. The programming cycle can take anywhere from 10 seconds to three minutes, depending on how much data is being transferred. A data byte of zero takes less time to process than non-zero data. By the way, don't remove or insert the 68705 when the red programming LED is on.

Looking ahead

This project offers an excellent way of not only using a 68705, but of learning about these versatile devices. We are planning a training module based around the 68705R3/U3 that will have on the one PCB a keypad, LCD display, A/D converter, D-A converter, 16 latched output lines, 16 buffered input lines, eight bi-directional lines and an RS232 port. The board will also have 4mm connectors, making it ideal for student use.

An example of a programming project might be to use the A/D converter of the 68705R3 to measure a voltage and display its value on the LCD display.

You could also send the measured value to a computer via the RS232 port, and give a warning beep with the D-A converter when the measured voltage exceeds a preset value as entered from the keypad.

There are many applications for the 68705, and projects featuring this IC are planned for future issues. In the meantime, you can develop your own with this project. ❖

Remote Control

Continued from page 73

If all is well, connect these inputs to the appropriate outputs of the receiver/-decoder board and check that the relays operate when the correct key is pressed.

In some cases, you might find the relays switching incorrectly. For instance, turning on one relay might turn off the other one. If so, try adjusting the transmitter frequency so it is backed off slightly from the maximum LED indication. This prevents the oscillator from remaining on for a few cycles after the key is released. If this doesn't cure the problem, you might need to fit a capacitor from each input (A and B) to ground. That is, across R3 and R6 in Fig.3. The value is not important, and can range from 1nF to 10nF. Alternatively, fit these capacitors at the outputs of the multiplexer.

Using the system

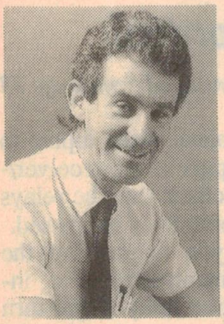
Once the unit is functioning, it remains to code the trinary encoder and decoder ICs. The transmitter and the receiver/decoder PCB's have tracks for logic 1 and logic 0 placed near the eight address pins of these ICs. Simply decide on an 8-bit code, which can include some pins left open-circuit, and connect the relevant address pins as required. The address pins for both ICs are pins 1 to 8.

The range of the transmitter is around 200 metres, although this will vary with the environment. As already mentioned, the optimum setting of the trimmer capacitor in the transmitter is slightly backed off from the maximum LED brightness.

The indicator output transistor on the relay board can drive a buzzer, lamp, a LED or anything within the specifications of the transistor. In many cases you probably won't need the indicator, unless the load being switched by the system is out of sight.

The relays supplied with the kit are not rated to switch a 240V appliance. If you want to do this, we recommend that you use the existing relays to operate another suitably rated relay. The main reason is that the PCB design is not intended to have 240V applied to any point. Using an off-board, mains rated relay solves this. The relays supplied with the kit have a contact rating of 5A.

The boards for the project are available separately from Oatley Electronics, so there's no limit to the type of system you can build — it's up to your imagination. ❖



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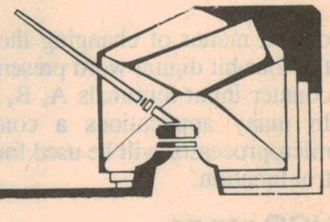


Conducted by Peter Phillips

Graphs, editing problems and some answers...

There's a few graphics this month along with the usual wide range of ideas, comments and suggestions. My introduction has been prompted by a letter the contributor doesn't want published, but you'll soon see what it's all about!

This column relies on letters from readers, and my task is to select those most likely to interest you all. I then edit the selected letters, usually to reduce their length, and prepare any diagrams that may be needed. To weld it all together I add my comments.

It's a time-honoured recipe, and one that seems to meet the approval of most readers. But not all! Some contributors are disappointed when their letter doesn't make the column, to the point of becoming quite irate. Sorry, but we need to retain the right to select the topics, although we do try to be very wide ranging.

And then there are those who refuse to permit editing of their contribution. This is an essential part of preparing the column and I work on the basis that if *I* can't understand what the writer is saying, then perhaps others won't either. In this case I edit the letter to try and make things clearer. Sometimes I get the writer's intention wrong and have to apologise when it's bought to my attention, but that's not usually a problem...

The most common type of editing is to reduce the length of the letter. This allows me to use more contributions and therefore keep more people happy. Sometimes I simply substitute a shorter word for a long one, or rearrange a sentence — basic stuff that goes on in all publications.

So what do I do when someone tells me I'm *not* to edit their contribution, unless it's by mutual agreement? Simple! That person's contributions go to the bottom of the pile, until I've got enough time to edit their letter and send them a copy for their approval. So far, I haven't found time to meet such a requirement, although fortunately it applies to only one or two contributors.

But be assured, if any contributor thinks I've added an incorrect term or modified the meaning of their letter, all they have to do is let me know and I'll acknowledge it as soon as I can. That's only fair. But like the choice of topic, we have to reserve the right to edit all contributions.

And so to our first topic.

Parallel resistors

This letter is one I've had on file for a while, and originates from a What?? question about the E12 range of resistors. I've not presented it before because the chart in Fig.2 was both a challenge and a time consuming thing to draw. I'll let our correspondent explain what it's all about...

In your What?? questions, you often deal with series connected resistors. However, I've found that parallel connected resistors are more useful to obtain a value not otherwise available in the E12 range. This can be done in a number of ways, such as with a computer program, a calculator (or slide rule), or with the chart shown in Fig.2.

*This chart is based on the principle that the intersection of two isosceles triangles can be found using the same equation to find the combined resistance of two parallel resistors. That is, R = (R1*R2)/(R1+R2). The diagram in Fig.1 shows two isosceles triangles, where their point of intersection is 6.66, which equals the parallel resistance of a 10 and 20 ohm resistor.*

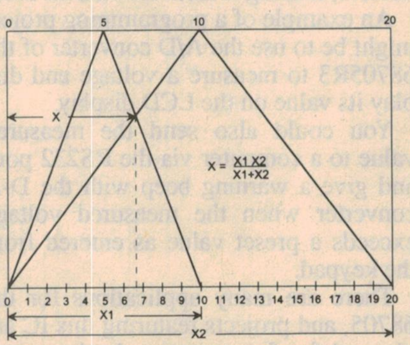


Fig.1

From this, it's possible to construct a chart plotting each resistor value in the E12 range (for one decade and a bit), and to show the intersection of each value. The chart is shown in Fig.2 and includes resistor values ranging from 4.7 ohms to 220 ohms. If you multiply all values by 10, 100 and so on, the chart can then cover another decade.

Therefore, to find a particular resistance value, simply note where two resistor values intersect. Obviously this applies only for resistors in the same decade. For instance, you can't use the graph to find the equivalent resistance of a 1.2k and a 150 ohm resistor connected in parallel. Alternately, if you have two resistors already in parallel, their combined resistance can be found from the graph. Naturally, you would need to allow for the tolerance of the resistors. (R.B., Turramurra NSW).

Thanks for sending us this idea R.B., I'm sure quite a few readers will find your graphical representation useful. It's the sort of chart you can hang on the workshop wall. Incidentally, I'm sure R.B. won't mind me mentioning that he is over 80, and still very involved in electronics. A hobby for a lifetime, it seems!

Field strength meter

The next 'graphic' comes from a reader who has calibrated the Relative

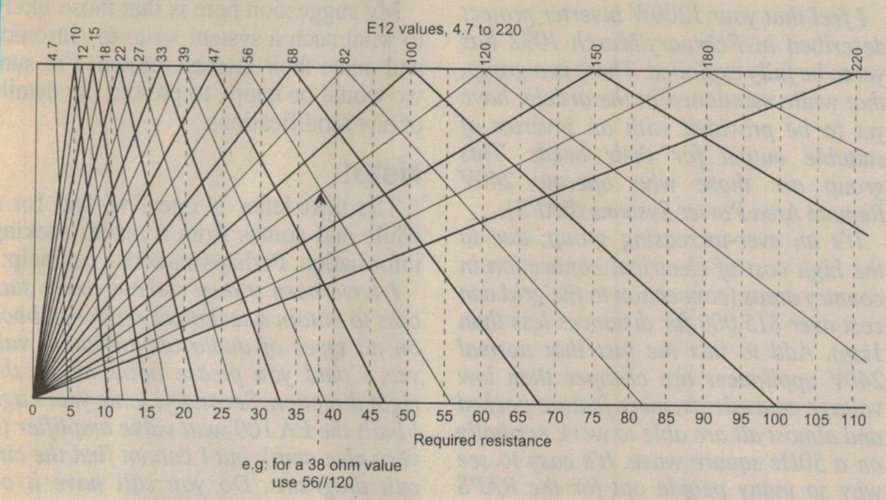


Fig.2

Field Strength Meter (RSFM) described in the August 1988 edition. Here's what our contributor has to say...

I thought your readers might be interested in the calibration curves for the RFSM presented in August 1988. The meter readings have been calibrated against a professional field strength meter. As you can see, the calibration varies with frequency, but is repeatable on the unit I have built.

It is unlikely that all RFSMs built will follow these curves, but they should give a rough idea of the actual signal strength being received. (M.H., Mordialloc Vic).

Thanks M.H., although as you can see, I have not included them all as space is limited. (R.M. supplied three calibration curves, one using a scale of 0 to 3000uV which only showed channel 2 extending beyond the 900uV point, and another calibrated in dB). The calibration curves showing meter reading versus an input level up to 900uV are shown in Fig.3.

Unfortunately, M.H. didn't supply any more information, such as the setting of the attenuation control or the position of the meter switch. I assume this is set to the 50 position. The graphs provided by M.H. were straight line plots, and I've redrawn these to show curves. The points shown on the graphs are the same as those supplied by M.H.

Hard drive problem

In January, I included a letter (from R.M, Newtown NSW) in which R.M. described a non-technical approach to fault-finding his hard drive. His method was to put the hard drive in the refrigerator — apparently effective, if rather different. The next letter suggests what, in fact, might be wrong with the drive:

I read with interest the letter concerning an Apple hard disk. R.M. certainly is ingenious in his repair methods!

My feelings on the fault with R.M.'s hard disk are based on a good deal of experience at both hobby and professional level as an electronics and PC workstation technician. The symptoms explained in his letter are a classical description of an older-style stepper motor hard disk, which simply needs a fresh low-level format.

With age, and because of heat and the fact that the heads move from being directly positioned over the tracks laid down during the initial low-level format, eventually the hard disk is unable to read the data on those tracks. This can manifest itself quite suddenly, as R.M. found, or it can manifest itself in bad sectors with 'drive not ready' messages and the like.

Heat sensitivity can also be severe, as the hard disk platter changes temperature and hence size (minutely). Stepper motor disks have an open-loop mechanism, whereas voice-coil disks have a servo mechanism, and therefore don't have the same problem in locating tracks.

I suggest R.M. low-level formats his disk and it may well perform for quite a bit longer. Incidentally, because of moisture which condenses when things are cold, it is prudent to take care with cooling components or assemblies in the 'fridge. Localised freeze-spray is a safer bet. I hope this helps. (D.B., Karuah NSW).

Thanks for this diagnosis D.B., it's one I wouldn't have thought of. I've heard of stepper motors in hard disks doing strange things because of an intermittent open-circuit in one winding and I thought this might be where the fault lay. Hopefully R.M. is reading, as the solution may be simpler than we all thought.

Darkroom timer

The next letter is a request for a project that we've certainly done before. However, our correspondent wants a couple of extras...

For some months now I have purchased your magazine and I must say I like the content and the readable way it's presented. While I don't profess to understand a lot of what I read, my enthusiasm for electronics probably comes from the interest my late father had in the hobby. However, my reason for writing concerns finding a suitable replacement for the old digital timer in my photographic darkroom. I now find the digits too small to see clearly, and I want to replace it. I have tried everywhere to buy one, but

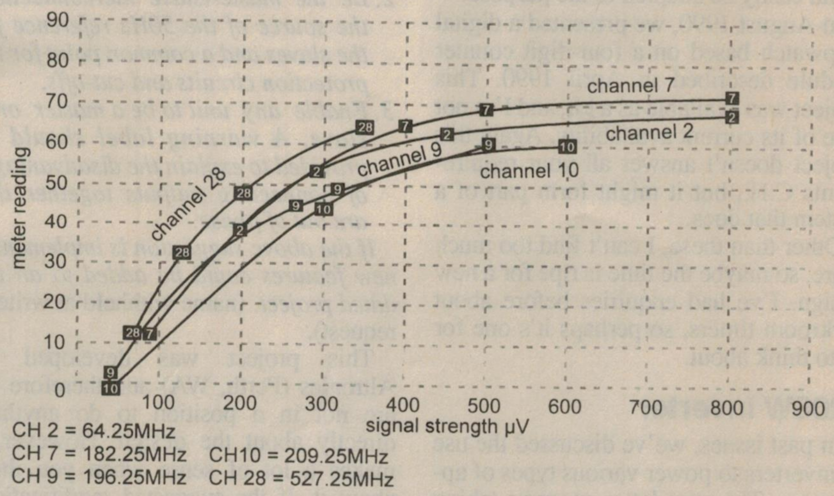


Fig.3

with no success. It occurs to me that if you have one as a project, I could build it. I have successfully built projects in the past, including a clock based on an American circuit that used Nixie tubes.

The requirements for the timer are quite simple. It should have four large red digits (15mm?), with a point between each pair, and be able to be set to the required time delay. Then, when the time has elapsed, it should emit an audible beep, preferably with a controllable volume. It would be good if the timer kept beeping and commenced counting up again. Not essential, but useful at times. A great advantage would be a memory that could hold predetermined times, which I could call up as required.

Has there been such a circuit published in the past? If not, where could I obtain such a circuit? Obviously it should use readily available components. (C.H., Yankalilla SA).

We have certainly published photographic timer designs in the past, C.H., although they don't have all the features you want. For instance, a digital photo timer was described in August 1986. This circuit uses the FND500 type 13mm red LED 7-segment displays. It doesn't have the memory or the beeping feature, but is quite versatile.

I notice on our database that a 'Big LED display module' was presented in August 1987, although I can't find the details. Perhaps it could be interfaced to your existing timer. Another design that might be suitable is the Super Timer described in December 1988. This timer also uses the FND500 type displays, but is not actually a darkroom timer. Still, it could easily be adapted to the purpose.

In August 1990, we presented a digital stopwatch based on a four-digit counter module described in April 1990. This project was available as a kit, and I'm not sure of its current availability. Again this project doesn't answer all your requirements C.H., but it might form part of a system that does.

Other than these, I can't find too much more, so maybe the time is ripe for a new design. I've had enquiries before about darkroom timers, so perhaps it's one for us to think about.

1200W inverter

In past issues, we've discussed the use of inverters to power various types of appliances. The next letter suggests taking this a bit further by modifying the Altronics 1200W inverter so it can be a part of a RAPS.

I feel that your 1200W inverter project described in February/March 1992 has yet to be fully exploited. There is a group, that while mentioned in the article, have yet to be provided with an inverter of suitable output for their needs. This group are those who operate 240V Remote Area Power Systems (RAPS).

It's an ever-increasing group, due to the high cost of electrical connection in country areas (connection to the grid can cost over $15,000 for distances less than 1km). Add to this the fact that normal 240V appliances are cheaper than low voltage equivalents, more feature packed and almost all are able to work normally on a 50Hz square wave. It's easy to see why so many people opt for the RAPS alternative.

Most RAPS are built around a diesel alternator providing 3-phase for machinery and 240V to charge a battery bank (sometimes supplemented by wind or solar power). The most popular battery voltage is 24V. Therefore, this is the required input voltage for an inverter to give 240V AC at about 3-4kW.

I am suggesting that if your inverter could be configured in the way that most commercial units can be, that is, a master and one or a number of slaves, and their outputs connected in parallel, three of your inverters could produce over 3kW continuous operation, and a 6kW surge. Add to this the fact that your inverter uses locally available parts and the circuit diagram is provided with full explanation. Therefore local repair is possible.

The modification I suggest is to add a multipin socket to the front panel that can:

1. *Have a jumper plug installed for solo operation.*
2. *Be the master/slave nterconnection, the source of the 50Hz reference for the slaves and a common point for the protection circuits and cut-offs.*
3. *Enable any unit to be a master or a slave. A warning label should be provided to explain the disadvantages of connecting outputs together that are out of phase.*

If the above suggestion is implemented new features could be added to an updated project. (name withheld at writer's request).

This project was developed by Altronics (Perth, WA) and therefore we are not in a position to do anything directly about the design. However, it makes a lot of sense when you think about it. If the suggested modifications were included, Altronics would serve a market that would probably buy several units at the one time.

My suggestion here is that those likely to want such a system write to Altronics and make their interest known. I'm sure we would be happy to present the details of any modifications.

Help!

The next letter is one I've had for a while and comes from a reader seeking information. Perhaps someone can help:

I have been trying without much success to obtain a technical reference book on all types of audio amplification valves. Could you please point me in the right direction. Secondly, some years ago I built the EA 100 watt valve amplifier (a very nice amp), but I cannot find the circuit diagrams. Do you still have it on file? If so, could I please have a copy.

Thirdly, I use an Azden WR-Pro wireless microphone system on my video camera when recording weddings. It works fine in most churches and buildings, but when used in or around old churches made of stone or whatever, the transmitted signal is often broken up, suffering interference and even disappearing altogether (can't find it anywhere).

Could you shed some light on this, and maybe suggest a way to boost the output power. The transmitter frequencies are 203MHz and 203.3MHz. (R.D., Wurtulla Qld).

As far as I know R.D., there are no current publications of valve data. The only thing I can suggest is to haunt second-hand bookshops for such a book, or perhaps even place an advertisement in our 'Marketplace'.

I still have my old Miniwatt Technical Data book, produced by Philips and printed in 1964. At the time it cost 25/- (25 shillings or $2.50) and even included semiconductor data. These were produced in quantity and it shouldn't be too difficult to find one.

About the valve amplifier you mention. We can help with circuit diagrams but you would have to apply to the Reader Services Section as shown on the last page. There's also a cost of $7.50 involved. Unfortunately technical help does not apply to this project as it's over five years old.

It's not really possible to advise you about the FM microphone. Perhaps the RF output of the transmitter is low, and maybe there's an adjustment inside the unit to tweak the tuning to increase the output. Unfortunately, the higher the frequency, the greater the risk of losing the transmission due to things like stone churches. Your unit operates above the standard FM band, and you might get better results with one that uses a frequency closer to 88MHz.

Microwave oven repair

In December I printed an enquiry asking if we knew of a book about repairing microwave ovens. It seems there is such a book, as the next writer informs us...

In response to D.C. Narangba, Qld, I have just purchased a book, titled 'Microwave Oven Repair' by Homer L. Davidson. I obtained my copy from McGraw-Hill, 4 Barcoo Street Roseville, NSW 2069. My copy cost $37.95 plus $6 postage.

As a novice at repairing household gadgets, I found the book extremely informative and full of very useful tricks of the trade, so to speak. Plus it really makes sure you are aware of the potential hazard from the high voltages inside, as you stated in the article. I hope this letter is useful to D.C. (G.C., Yarram Vic).

It's probably coincidence, but not long after preparing the December column, which included D.C's request for information on microwave oven repair, I accidentally destroyed the family's microwave oven. The sequence of events doesn't matter, suffice it to say I switched it on with nothing inside the oven and proceeded to have a shower in preparation for the day's toil.

Within seconds there were screams of "the microwave's on fire" and sure enough, no hot porridge that day. So far I haven't even looked inside it, but I suspect it's repairable as the magnetron still works. For now it's back to conventional cooking.

So it's likely quite a few people could be interested in knowing about microwave oven repair. As I've discovered, it's easy enough to damage them. So thanks for your letter G.C., I'm sure many readers will be interested.

Car alarms

Our last letter this month is from a regular contributor who specialises, it seems, in many things. Here's an interesting and simple modification to help those types of car alarms that trigger from a drop in battery voltage:

Many types of car alarms are triggered by the tiny sudden voltage change caused by a voltage drop created in the main battery cables and wiring when the roof or boot light is switched on. If the wiring is good and heavy (as mine is), the voltage drop can be insufficient to operate the alarm. The supplier suggests connecting at a point more remote from the battery if this happens, but it's not always easy to do.

Another way would be to increase the lamp 'in-rush' current by using higher wattage bulbs, but this may create excessive heat in the light fittings. Since only a brief current blip is required, I soldered electrolytic capacitors directly to the bulb end caps to give a short heavy pulse of charging current. About 33uF is sufficient and the capacitors are small enough to fit in the housings, be supported by their connecting leads and be far enough away from bulb heat to avoid damage.

Correct polarity was observed and the original bulbs complete with their soldered-on capacitors will probably still be there when the car is finally junked. I happened to have had spare 33uF, 16V capacitors; smaller ones could well be OK. Watch for possible movement of bulbs due to vibration and the unbalanced weight of the capacitors to ensure a short-circuit can occur. (R.V., St George's Basin NSW).

As ever R.V., thanks for this simple idea. It occurs to me that this could also be used to reduce the sensitivity of these types of alarms. By adding the capacitors, the sensitivity adjustment could be set back, possibly preventing false triggering.

What??

This month's question comes from Brian Byrne, of Indooroopilly (Qld). It's a relatively simple question this time, in response to comments I sometimes receive that the What?? questions are too hard. Brian writes:

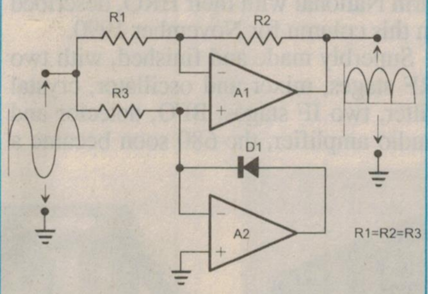


Fig.4

It's puzzle time again. Consider: your boss in a solenoid manufacturing business says to you "here's 16 dry cells, each 1.5V and with one ohm internal resistance. Connect all of 'em so they can deliver the maximum total current through a one ohm load". Easy isn't it? Try for a solution in one minute!

Answer to February What?

The circuit is shown in Fig.4. On the negative half-cycle of the input, op-amp A2 will force its (-) input to 0V because the output of A2 will be positive, forward biasing D1.

The op-amp will conduct to keep the voltage at the (-) input equal to that at the (+) input. Therefore, the non-inverting input of A1 will be 0V and the output will be an inverted (positive going) replica of the input signal.

On the positive half-cycle, both inputs of A1 will be equal to the positive half-cycle. Therefore, no current will flow in R1, and to maintain zero current in R2 the output of A1 will also equal the positive input half-cycle.

In practice, the source impedance should be low to prevent the difference in the input resistance between the positive and negative half-cycles from loading the source. A voltage follower between the source and the input of the circuit will solve this problem. ❖

NOTES & ERRATA

IMPROVED 50MHZ FREQUENCY COUNTER (February 1993):

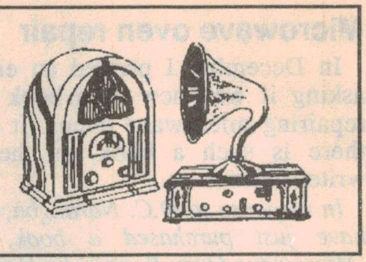
Resistor R15 should have been shown as 12 ohms, not 27. Also to prevent overheating of the 5V regulator U11, the counter should be operated from either 9V DC or 7.5V AC. A plug-pack supply rated at 400mA or more is suitable.

Note that multiplexing noise currents in the earth tracks of the counter's main PCB can cause a small residual reading with no input. This can be minimised by cutting the earth track at the rear edge of the PCB, alongside capacitor C1. To restore earth line continuity, a short length of insulated hookup wire can be used to connect the earthy side of C7 to the earthy side of C5.

Finally, it has been found that although some brands of 74HC390 device in position U2 will typically allow the counter to achieve operation to 50MHz, others will not — using the original configuration for U2a. However this shortcoming can be obviated by changing the connections to U2a so that the /2 stage is ahead of the /5 stage, rather than after it.

To make this change, cut the track leading to pin 4, the track connecting pins 1 and 7, and also both tracks connecting to pin 3. Then using a short length of tinned copper wire, connect pin 3 to pin 4; also using short lengths of insulated hookup wire, connect pin 1 to the 'INA/1' PCB pin, and pin 7 to both pin 12 and the 'INA/10' PCB pin.

A revised version of the 93c2A board pattern, incorporating both of the above changes, has been sent to PCB manufacturers. ❖



by PETER LANKSHEAR

The Eddystone 940 communications receiver

To many enthusiasts, a major attraction of vintage radios is their handsome wooden cabinets. But there is an important and increasingly popular class of receiver which even their most enthusiastic admirers would not call beautiful: the communications receivers, which as their name implies were intended for communicating rather than entertainment.

The classic communications receivers had superior standards of construction and performance, and prices to match — with some costing as much as small cars. Interest in this class of receiver is growing, and there are even 'one brand' societies with international memberships for such legendary makes as Collins, National HRO, Racal and Eddystone.

There is no precise definition, but it is generally accepted that communications receivers should be constructed to high standards with superior performance, stability and flexibility. Controls for many of the internal circuits are available to the operator, who is expected to have some technical knowledge. Other standard features are accurate and resettable dial readouts, beat frequency oscillators and, in more recent models, detectors suitable for single sideband (SSB) reception.

Many readers, especially those with amateur and DXing interests, will be familiar with the name of Eddystone, the brand name of equipment from the British company of Stratton & Co. — which was founded in the early 1920's and is now part of the Marconi group. A maker of fine shortwave components and receivers, Eddystone produced a wide range of communications receivers for marine, military and professional work as well as high performance general-purpose and amateur models which became popular with enthusiasts throughout Australia and New Zealand.

Favourite model

In 1949, Eddystone commenced production of the landmark professional general coverage model 680, covering from 480kHz to 30MHz. Like many very successful communications receivers, the 680 used the circuit concept pioneered 15 years previously by American firm National with their HRO, described in this column for November 1990.

Superbly made and finished, with two RF stages, mixer and oscillator, crystal filter, two IF stages, BFO, detector and audio amplifier, the 680 soon became a favourite and was followed during the next decade by the 680/2 and 680X.

In 1962, a new receiver replaced the 680. Considered by many to be the best-ever general coverage Eddystone receiver, the 940 retained the HRO circuit format, but with a product detector for SSB operation and a special low noise input stage. As well as the general purpose model described here, there were military and coastguard versions. Although produced concurrently with early solid state communications receivers, at 30 years of age, Eddystone's 940 is already old enough to be eligible for vintage status.

Solid construction

In common with most true communications receivers, even those built today, the 940 is massively constructed. Mechanical stability is extremely important for this class of equipment, and an Eddystone specialty is its high quality diecastings. For example, sheet metal front panels were not good enough. In-

Fig.1: The 940 Communications Receiver. Post-1950 Eddystones featured large, easily read dials and smooth drive assemblies, with no perceptible backlash.

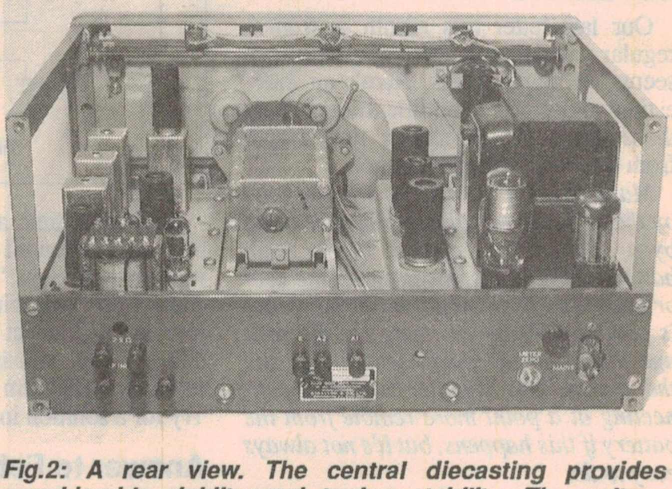


Fig.2: A rear view. The central diecasting provides considerable rigidity and tuning stability. The voltage regulator tube is visible on the right, with the rectifier.

CAPACITORS

C1–5, 18–22, 33–37, 49–53 : 3–30 pf Air Trimmer.
C6, 23, 38, 58, 60, 69 : 20 pf Silvered Mica ±10% 350V DC.
C7, 24, 39, 56 : 10 pf Silvered Mica ±10% 350V DC.
C8, 25, 40 : 12 pf Tubular Ceramic ±10% 350V DC.
C9, 26, 41, 63 : 4-gang Air Spaced Variable.
C10, 27, 42, 48 : 100 pf Polystyrene ±5% 350V DC.
C11, 12, 14, 29, 44, 71, 78, 80, 81 : 0·1 uF Plate Ceramic - 80 —20% 200V DC.
C13 : 0·003 uF Metallised Paper ±20% 350V DC.
C15, 28, 30, 43, 46, 64, 73–75, 79, 82, 83, 89, 92 : 0·047 uF * Polyester ±10% 400V DC.
C16, 17, 31, 32, 91 : 6 pf Tubular Ceramic ±10% 350V DC.
C45, 88, 93 : 50 pf Tubular Ceramic ±10% 350V DC.
C47, 86, 87 : 100 pf Tubular Ceramic ±10% 350V DC.
C54 : 0·004 uF Silvered Mica ±1% 350V DC.
C55 : 3625 pf Silvered Mica ±1% 350V DC.
C57 : 1625 pf Silvered Mica ±1% 350V DC.
C59 : 1200 pf Silvered Mica ±1% 350V DC.
C61 : 400 pf Silvered Mica ±1% 350V DC.

*0·05 uF may be fitted as alternative.

C62 : 15 pf Tubular Ceramic ±10% 350V DC.
C65, 76, 77, 84, 85 : 0·001 uF Polystyrene ±5% 125V DC.
C66, 67 : 0·002 uF Polystyrene ±5% 125V DC.
C68, 98 : 3–11 pf Air Spaced Variable.
C70 : 390 pf Polystyrene ±5% 125V DC.
C72 : 0·25 uF Metallised Paper ±20% 150V DC.
C90, 101, 103–105, 107 : 0·01 uF Tubular Ceramic ±20% 350V DC.
C94 : 0·01 uF Metallised Paper ±20% 150V DC.
C95, 96 : 500 pf Metallised Paper ±20% 350V DC.
C97 : 0·005 uF Tubular Ceramic ±20% 350V DC.
C99 : 200 pf Silvered Mica ±5% 350V DC.
C100 : 10 uF Tubular Electrolytic 16V DC.
C102, 106 : 25 uF Tubular Electrolytic 25V DC.
C108 : 32 · 32 uF Tubular Electrolytic 350V DC.
C109 : 50 uF Tubular Electrolytic 450V DC.

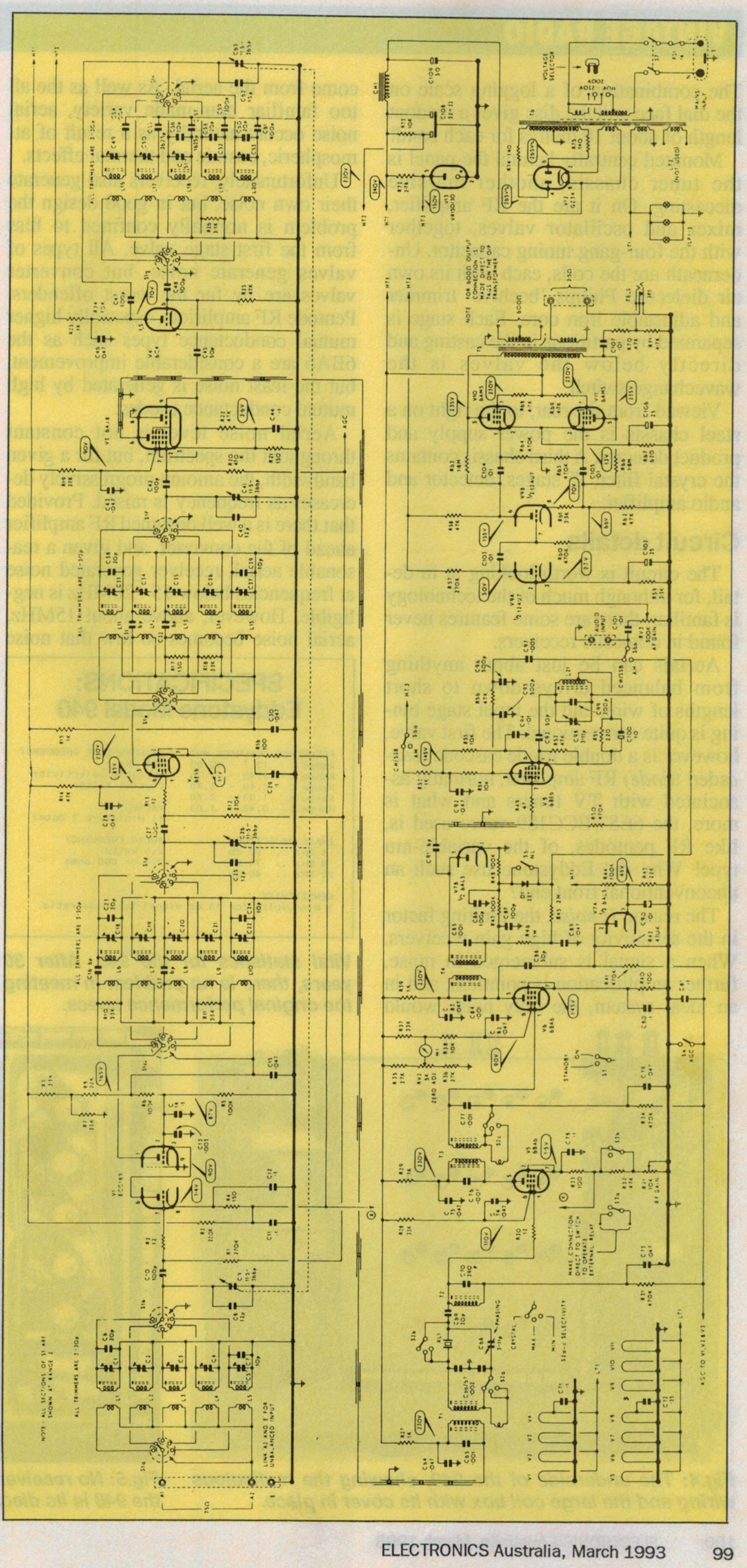
RESISTORS

R1, 12, 57 : 0·27 MΩ ±10% ½ watt.
R2, 13, 30 : 12Ω ±10% ½ watt.
R3 : 0·22MΩ ±10% ½ watt.
R4, 17, 21 : 150Ω ±10% ½ watt.
R5, 6, 44, 47, 48 : 0·1MΩ ±10% ½ watt.
R7, 28, 37 : 33,000Ω ±10% 1 watt.
R8 : 2,200Ω ±10% ½ watt.
R9 : 3,300Ω ±10% 1 watt.
R10, 11, 18, 26, 59, 61 : 3,300Ω ±10% ½ watt.
R14 : 47,000Ω ±10% 1 watt.
R15, 23, 27, 29, 39, 53 : 1,000Ω ±10% ½ watt.
R16, 33, 40 : 100Ω ±10% ½ watt.
R19, 35, 36 : 27,000Ω ±10% 1 watt.
R20, 31, 34, 41, 42, 50, 60, 64, 65 : 0·47MΩ ±10% ½ watt.
R22, 25, 32, 52, 56, 58, 62, 70 : 47,000Ω ±10% ½ watt.
R24, 54, 55 : 10,000Ω ±10% ½ watt.
R38, 73 : 10,000Ω ±10% 1 watt.
R43 : 22,000Ω ±10% ½ watt.
R45 : 2MΩ ±10% ½ watt.
R46 : 1MΩ ±10% ½ watt.
R49 : 47Ω ±10% ½ watt.
R51 : 220Ω ±10% ½ watt.
R63, 66 : 1·8MΩ ±10% ½ watt.
R67 : 620Ω ±10% ½ watt.
R68, 69 : 4,700Ω ±10% 1 watt.
R71 : 4,700Ω ±10% ½ watt.
R72 : 2,700Ω ±5% 6 watt wire-wound.
R74, 75 : 140Ω ±5% 6 watt wire-wound.

VOLTAGES

All voltages indicated on the circuit above were taken using a meter of 20,000Ω/V sensitivity and an applied mains voltage of 240V. A variation of ±5% should be allowed and readings should be taken between the point indicated and chassis. Range switch should be at '5.' Gain controls at maximum. Mode switch to CW, SSB, Standby switch to ON and AGC OFF.

Fig.3 (right): The complete schematic for the Eddystone 940, which used a total of 11 valves plus rectifier. The component values are shown above.



stead, an intricate moulding provides a panel with superb rigidity and stability as well as good looks.

Half the front panel area is taken up by the tuning dial. Below it are the controls, dominated by the two large knobs for tuning and band change. Other control knobs and switches are placed symmetrically on either side.

Eddystone were leaders in dial drive construction, and for many years sold uncalibrated dial units for incorporation in high class projects. For the uninitiated, to turn the tuning knob of an Eddystone receiver is a revelation in smoothness and precision, with absolutely no backlash evident at all.

A few flicks of the 940 tuning knob are sufficient to spin the combination of a flywheel and loaded gears the 70 turns necessary to traverse the entire dial. The tuning scales are about 320mm long, providing a 10kHz resolution on all but the highest frequencies. However, it is the logging scales that make resetting of tuning precise. Behind the dial is a 150mm diameter disk with calibrations on its edge visible through a window.

The combination of a logging scale on the dial face and the disc gives a readout length of about 10 metres for each band!

Mounted centrally behind the panel is the tuner chassis, another massive diecasting. On it are the RF amplifier, mixer and oscillator valves, together with the four-gang tuning capacitor. Underneath are the coils, each with its own air dielectric Philips 'beehive' trimmer and adjustable iron core. Each stage is separated by partitions in the casting and directly below the valves is the wavechange switch.

Viewed from the rear, to the right on a steel chassis is the power supply and product detector. A third chassis contains the crystal filter, IF stages, detector and audio amplifier.

Circuit details

The circuit is worth looking at in detail, for although much of the technology is familiar, there are some features never found in domestic receivers.

Aerials can be just about anything from balanced arrays down to short lengths of wire, and the input stage tuning is quite conventional. The first valve, however is a double triode cascode (*cas*caded tri*ode*) RF amplifier, normally associated with TV tuners and what is more, the 6ES7/ECC189 valve used is, like RF pentodes, of the variable-mu type! Why did Eddystone use such an unconventional front end?

The reason is *noise*, the limiting factor in the sensitivity of high gain receivers. When a signal is submerged in noise, further amplification is pointless, and in an ideal system, the only noise would come from the aerial. As well as the all too familiar man-made variety, aerial noise occurs naturally as a result of atmospheric, cosmic and thermal effects.

Unfortunately, receivers also generate their own noise, but in good design the problem is normally confined to hiss from the first stage valve. All types of valves generate noise, but converter valves are by far the worst offenders. Pentode RF amplifiers, especially higher mutual conductance types such as the 6BA6 are a considerable improvement, but the least noise is generated by high mutual conductance triodes.

Aerial noise level is not constant throughout the spectrum, but for a given bandwidth, the amount progressively decreases as frequency is raised. Provided that there is a well designed RF amplifier ahead of the converter, and given a reasonable aerial, receiver generated noise at frequencies below 15 - 20MHz is negligible. However, above about 15MHz, aerial noise becomes so low that noise generated in the first valve does become significant and the reason that triode RF amplifiers were used extensively in valve TV tuners.

SPECIFICATIONS: Eddystone Model 940

FREQUENCY COVERAGE MHZ
Range 1 12.7 - 30.00
Range 2 5.40 - 12.70
Range 3 2.40 - 5.40
Range 4 1.03 - 2.40
Range 5 0.48 - 1.03

INTERMEDIATE FREQUENCY
450 kHz
Variable selectivity
Crystal filter

VALVES
11 Miniature 2 Octal

IMAGE REJECTION
1 MHz .. 90 db
8 MHz .. 75 db
20 MHz .. 40 db

AUDIO FREQUENCY
2.5 watts
2.5 or 600 ohms

SENSITIVITY
3 microvolts for 15 db signal-to-noise ratio.

Vital statistics for the 940. After 30 years, there is no problem in meeting the original performance specs.

The problem is that simple triodes are unstable as RF amplifiers. A very effective way of taming them is by the cascode connection, in which the input triode is a conventional amplifier driving the cathode of a grounded-grid second amplifier. By preventing any coupling between the first and second tuned circuits, the cascode connection provides a high gain, stable and very low noise RF amplifier. The variable-mu characteristic of the ECC189 permits the application of full AGC to the cascode stage.

Second RF stage

Next in the Eddystone 940 is a second RF stage, this time a more conventional type using a 6BA6/EF93 pentode. Its purpose is to provide additional amplification and most importantly, extra selectivity for improved image rejection on the higher frequency bands. With the intermediate frequency of 450kHz, the image is only 900kHz from the fundamental. Thanks to the use of this second stage with its additional preselection, at 20MHz the image rejection of the 940 is 40dB. Many domestic receivers would have difficulty in achieving 10dB at this frequency.

Only the heptode section is used in V3, a 6AJ8/ECH81 frequency converter. V4, a separate 6C4/EC90 triode tuned anode oscillator is coupled into the injection grid of the heptode. Use of a separate oscillator valve for improved stability was frequent in top-line communications

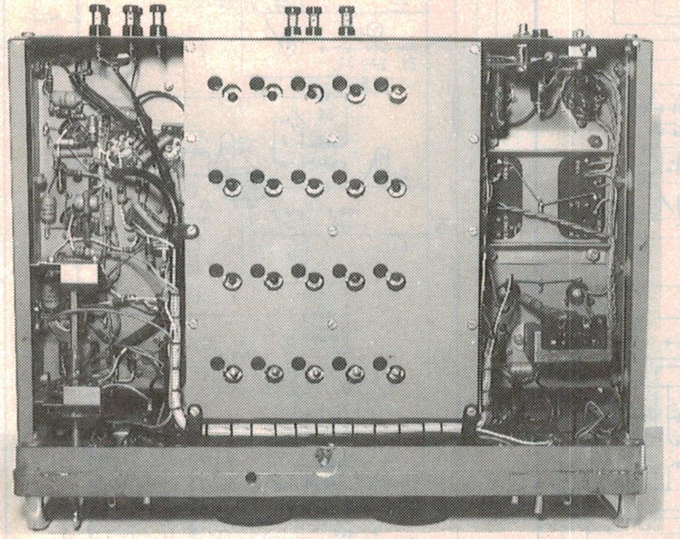


Fig.4: The underside of the 940, showing the meticulous wiring and the large coil box with its cover in place.

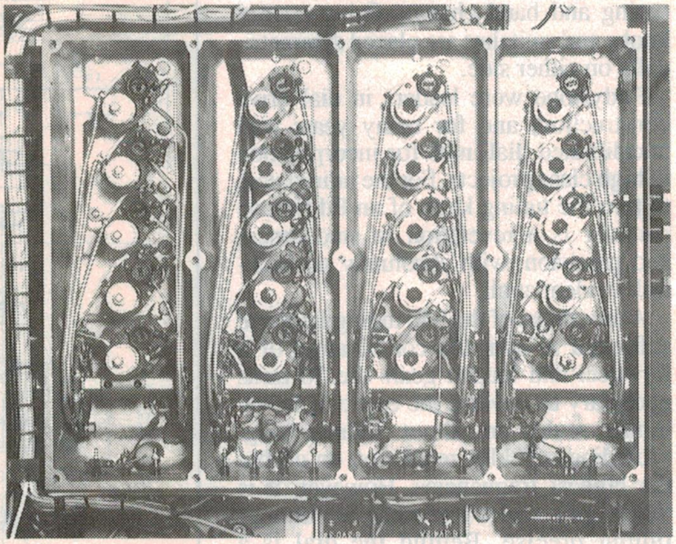


Fig.5: No receiver can be better than its coils. The heart of the 940 is its diecast coil box and RF chassis, shown here.

receivers. The oscillator HT supply is regulated at 150 volts by the VR150/30 gaseous voltage regulator valve V13.

Variable selectivity

Apart from using more modern components, the two stage IF amplifier with V5 and V6, 6BA6/EF93 type valves is little different from the ancestral HRO. Variable IF selectivity is controlled by a three position switch. In the sharpest position, with a bandwidth of only 400Hz at 6dB down, there is a crystal filter — remarkably similar to the pioneer Robinson design used in the 1930 Stenode receiver. In fact like the Stenode, the quartz crystal is sealed in a valve envelope, in this instance the small B7G size.

The second position of the selectivity switch short-circuits the crystal and provides a 4kHz bandwidth at the 6dB point. In the broadest position, the IF transformers are overcoupled by switching in extra windings, producing an overall bandwidth of 10kHz — suitable for high quality reception.

As communications receivers are frequently associated with transmitters, standby switches are a standard fitting. This switch on the 940 controls the cathode circuit of the first IF amplifier and has an extra pair of contacts to control a transmitter on/off relay.

A carrier level meter monitors the changes in the screen grid current caused by AGC action on the the second IF stage. Although not a true 'S' meter, it nevertheless provides a useful indication of signal strength. As automatic gain control is normally switched off for single sideband and code reception, communication receivers also have manual RF and IF grid bias gain controls. The 940 manual control is a 10k pot in series with the cathodes of the four valves in these stages.

Two detectors

Although there are several differences in detail, and at first glance they look complicated, the AGC and detector circuits of the 6AL5/EAA91 double diode are basically conventional. V7A is a delayed AGC rectifier, fed from the anode of the second IF valve V6. However instead of the usual 2-3 volts of delay found in domestic receivers, the 940 has no less than 45 volts! This is an illustration of how the gain of a large receiver differs from a domestic model. To have any less delay would result in internal noise creating sufficient AGC voltage to desensitise the controlled stages.

V7B is a diode detector used for AM transmissions. But the circuit incorporates a *noise limiter*, a device not found in domestic receivers. Bangs and crashes from static, and impulse noise from automotive ignition can be very tiresome. Noise limiters provide some relief and the 940 uses D1, a silicon diode for this. R45, R46 and C49 filter the voltage developed across the load of V7B to provide a bias voltage proportional to the strength of the received signal. When a noise pulse exceeds the bias, D1 ceases to conduct and no signal is passed on to the audio amplifier.

The product detector V8, a 6BE6/EK90, functions much like a superhet mixer, with the inner grid and screen grid used in a beat frequency oscillator which is tuneable either side of 450kHz. When used as a beat frequency oscillator (BFO) to make CW transmissions audible, the oscillator and incoming signals are mixed together to create a heterodyne at the anode of V8.

The other use of the product detector is the related function of reception of single sideband transmissions (SSB), frequently used for radiotelephone traffic. By eliminating the carrier and one sideband from the transmission, there can be considerable savings in power and spectrum space. The remaining sideband can convey all the necessary information, but it must again be demodulated by a carrier recreated by a local oscillator (the BFO) in the receiver.

No loudspeaker

Although not primarily intended for high fidelity listening, the Eddystone 940 has a good quality audio system. V9 is a 12AU7/ECC82 double triode, operating as a voltage amplifier and split load phase inverter. This drives a push-pull pair of 6AM6/EL91 medium sized output pentodes, producing a rated audio output of 2.5 watts.

As was quite common with valve communications receivers, there is no internal loudspeaker. Instead, there is provision for either an external 2.5-ohm speaker, a pair of headphones or a 600-ohm audio line.

Faultfinding

As would be expected with equipment of the quality of the 940, reliability is very high and it is a rarity for Eddystone-made components to fail. However minor items such as valves, bypass capacitors and resistors can fail and normal servicing methods, especially voltage checks, will normally soon locate faults.

Two unusual resistor-related problems were found in the receiver illustrated. First, the cascode amplifier did not seem to be contributing any gain. As the socket is completely hidden under the wavechange switch, voltage measurements were not possible. By unplugging the valve, and measuring from above the chassis, it found that there was no voltage present on pin 2. Resistor R6 was open, and R8 was twice its rated value.

After repairs, operation with manual RF/IF gain was normal, but very poor with AGC. R44 had become open circuited, removing the 45-volt delay from the diode V7A and permitting noise to operate the AGC.

After servicing and realignment with the aid of a Marconi 2022 precision frequency synthesised RF generator, performance of the 940 was measured. Even at 27MHz it can still meet the original signal to noise specification. After 30 years, that is *quality*. ❖

50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

March 1943

Harder than sapphire: How was a practically bankrupt Germany able to build her truly terrific war machine in the six short years between the burning of the Reichstag in 1933 and the outbreak of World War II? The popular answers are Germany's 'will to win', a regimented population and German technical ingenuity. But tungsten carbide may have been a decisive factor in building Hitler's arsenal.

Harder than sapphire and very nearly as hard as diamond, tungsten carbide was invented in Germany round about 1915, and was taken over by the Krupp interests in 1916. The famous Big Bertha which shelled Paris from a range of 70 miles was tooled with tungsten carbide, and the new material gave Germany a decided advantage over the Allies (who had developed nothing comparable) in armament production.

New surgical instruments: Army surgeons in the Middle East are using new types of surgical instruments which 'floodlight' the interior of the body.

Made of a transparent plastic material, which transmits light round corners, does not conduct heat, and is virtually unbreakable, the new instruments of methylmethacrylate plastic come in many shapes to suit any kind of operation. They will withstand any amount of sterilising by boiling without losing their shape.

March 1968

Video telephones: Video telephone equipment is being marketed in Japan by Nippon Electric. Four models are available from the company using two different types of video display. One is scanned at 275 lines and the other at 525 lines. In all models an automatic control system is incorporated to ensure a clear picture image.

The company is also marketing with the equipment a laser relay system for vision and audio. Another accessory is a video repeater amplifier for signals transmitted over distances beyond about 6 miles. Cost varies but in a set involving a minimum of 20 circuits, the cost is about $800. Other manufacturers in Japan are also working on video telephones.

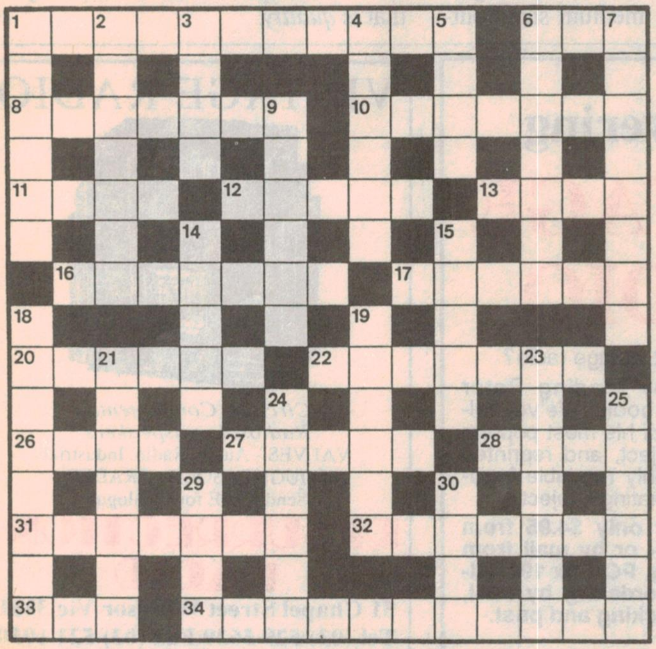
Cryogenic measurements: A possible method for measuring directly the absolute temperature of a metallic conductor in the range from 0.001 to 10K, with no calibration required, has been proposed by the Cryogenics Laboratory in Boulder, Colorado.

The phenomenon on which the prediction is based is electrical noise — a fluctuation in all metallic conductors due to the Brownian motion of the electrons. The magnitude of this voltage varies as a function of both temperature and resistance of the conductor, and becomes very small at low temperatures. However, it should be detectable with the aid of the Josephson effect, which occurs when two superconductors are connected by a weak junction. ❖

EA CROSSWORD

ACROSS

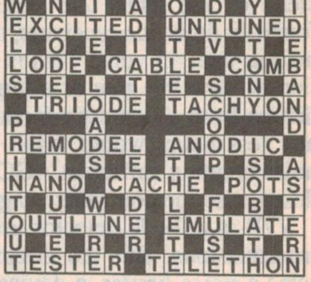
1. Said of elements undergoing emissive atomic disintegration. (11)
6. Radio-frequency interference. (1,1,1)
8. This measures coulombs per second. (7)
10. Varied slightly from setting or value. (7)
11. Distributive cable. (4)
12. Data given to system. (5)
13. Quantity equivalent to energy. (4)
16. Sparking component in gas heater. (7)
17. Person successful in EA contest. (6)
20. Howard ——, famous US industrialist. (6)
22. Contrivances; ingenious devices. (7)
26. Mathematical average. (4)
27. Move or adjust to correct position. (5)
28. Abbreviated term for measure of hotness. (4)
31. Specialised speaker. (7)
32. Component of a fluorescent light fitting. (7)
33. Unit of absorbed dose of ionising radiation. (3)
34. X-ray photography. (11)



DOWN

1. Again sets alarm system. (6)
2. Reducing oscillations. (7)
3. Co-discoverer of fission, —— Hahn. (4)
4. Element 49. (6)
5. Give off radiation. (4)
6. Instruct in new career. (7)
7. Organised manufacture and trade. (8)
9. That which sounds a bell. (6)
14. Picture tube element. (5)
15. Circular interference fringes, Newton's ——. (5)
18. One of the functions of a multimeter. (8)
19. Measuring instruments. (6)
21. A green light? Yes! (2-5)
23. Likely place for an arboreal lightning strike. (7)
24. First name of Nobel, founder of prizes. (6)
25. Inventor of navigational gyroscope. (6)
29. Stellar object. (4)
30. Word on aneroid barometer. (4)

SOLOTION FOR FEBRUARY 1993



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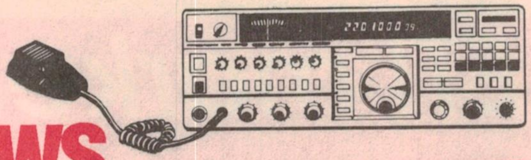
Amateur Radio News



New radio club formed in Sydney

A new club has been formed in Sydney, the Sydney Progressive Amateur Radio Club (SPARC), which is dedicated to an important project: turning the old Middle Head radio monitoring station into a communications museum.

The station is located in the newly established Sydney Harbour National Park, and was recently decommisioned after use by a state government department.

Although the NSW Government plans to dismantle the station, the amateurs behind the formation of SPARC believe it should be preserved as part of Australia's radio heritage, and used as the core of a working museum for communications technology.

Those interested in taking part in the project are invited to contact either Club secretary Alan Avery on (02) 969 6721, or Peter Jensen VK2AQJ on (02) 960 1486.

Picnic day at Mt Pleasant, SA

Steve Johnston VK5ZNJ, president of the Barossa Amateur Radio Club, advises that the Club's fourth annual Mt Pleasant Picnic Day is being held late this month, on March 28.

This year's Picnic Day is planned to be much larger than in previous years, with a theme covering all forms of electronics rather than just amateur radio. Among others, the Club is hoping to attract CB operators in the hope of encouraging them to upgrade to amateur radio.

The event is being held at the Talunga Park Showgrounds at Mt Pleasant, and will be open to the public between 1000 and 1600 hours (10am - 4pm). There will be activities for young and old, with the usual Transformer Throwing Competitions, inter-club Tug-Of-Wars, etc., plus displays by the Royal Flying Doctor Service, OTC and emergency service organisations (including WICEN).

A display of vintage military communications equipment will also be set up in the Agricultural Hall, and throughout the day raffles will be held with prizes donated by the event's sponsors. A large area is being set aside for 'buy and sell' trading tables.

Major sponsor of the event is Dick Smith Electronics, while other sponsors are Castrol Australia, Johnston Electronic and Audio Visual Services, Countrywide Mobile Communications and GME Electrophone.

PA facilities are also being provided by Geoff VK5TY and Christine VK5CTY, of Owen Sound. Most of the sponsors will be providing displays and trade stands in the Main Hall, along with organisations such as Scout Communications, Lencom Antennas, Codan, Microwave Developments, Stewart Electronic Components and the WIA Equipment Supplies Committee.

Further information on the Mt Pleasant Picnic Day is available from BARC secretary Steve Bigg VK5BCD, who can be contacted on most evenings on (085) 23 0628.

New licence conditions coming

The WIA's general manager and secretary Bill Roper VK3ARZ reports that last year's SEANET Convention in Darwin was the scene for the announcement of forthcoming changes to the amateur radio licence conditions, given by the Hon. Warren Snowden MP, standing in for the Minister for Transport and Communications, Senator Bob Collins.

Most WIA members will have heard the broadcast speech, which indicated that the proposed changes to the licence conditions would come into effect 'early in 1993' and that the specifics of the proposal would be published in *AR* magazine 'very soon'.

It's expected that documentation will soon be forthcoming from the DoTC, despite a delay in drafting sections of the revised licence conditions. Meanwhile, here are the main points outlined in the announcement:

Introduction of a no-code Novice Limited class of licence allowing use of voice and packet radio transmissions in the 144MHz and 432MHz bands;

Allowing Limited Licensees use of FM telephony on the 29MHz band, encouraging more use of 10m.

Holders of the Combined Novice and Limited class of licence would be recognised under a single category to be known as the Intermediate class licence.

Novice stations to be permitted a limited increase in power, consistent with the state of technology and the availability of equipment.

Usage of packet radio technology will see unnecessary technical rules removed.

Rules applying to the use of repeater stations will be simplified.

In his address, Mr Snowden said many of the previous rules were unnecessarily restrictive and impeded the use of new technology.

He went on to add "I would like to congratulate the Wireless Institute of Australia for its valuable contribution on behalf of its members to the development of reforms to further deregulate the service for the benefit of the amateur operators throughout Australia."

ZL's 'Have A Go' activity on 160m

The popular 'Have A Go on 160m' event for enthusiasts and experimenters will be on again this month (March), hosted by the Hastings Branch 13 of the NZART.

It's not a contest, just an activity to encourage experimentation on the band as well as some recreation. However to provide flexibility and to encourage and enable the use of enhanced antennas, the organisers have scheduled the activity to coincide with the NZART Field Day. While not forming any part of the Field Day contest itself, it will provide a chance, the organisers say, to guarantee a result for your experimental effort.

The 160m Have A Go Activity will run in two time blocks, from 2000 hrs NZT on Friday March 5 to 0300 hrs NZT Saturday March 6, then from 2000 hrs on March 6 to 0300 hrs on Sunday March 7.

The 'prime' frequency is 1840kHz, but you are encouraged to use anywhere in the band, as has happened in past events. Mode is LSB or CW.

The contact for more information is David Walker ZL3DK, 36 Ardrossan Ave, Flaxmere, Hastings NZ.

Amateur statistics

As at 30 September 1992, there were 18,701 station licences held by Australian radio amateurs. The 'most populous' state is NSW, with 5461 licences held, followed by Victoria, with 5002.

The number of repeater licences is 320, 85 of which are in NSW and 84 in Victoria, while Queensland follows close behind with 70. There are 28 beacon licences. ❖

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NEWS HIGHLIGHTS

OPTUS OPENS $100M TECHNICAL CENTRE

Federal Minister for Transport and Communications, Senator the Hon. Bob Collins, has officially opened the new Sydney Technical Centre for Optus Communications. Developed at a cost of $100 million, it is the 'nerve centre' of what is claimed to be the world's most advanced telecommunications network.

Located in Rosebery, in the inner southern suburbs of Sydney, the multi-story complex houses the main monitoring and control centre of Optus' Australia wide network, the digital switches that link Sydney with the rest of Australia and the world, the computers and operations support systems (OSS) software which drives the network, and a state of the art 700m^2 facility dedicated to technical education, training, research and development.

Speaking at the opening, Optus CEO Bob Mansfield said that the organisation's overseas contacts were amazed that the Centre had been built in only six months. "They say it would have taken at least three times as long, overseas. It shows what Australians can do, when they really put their minds to it", he added.

The Optus Network is the world's first to be based completely on the advanced Synchronous Digital Hierarchy (SDH) standard. At the heart of the network are three atomic clocks, accurate to one part in 10^{12}, which provide timing pulses for synchronising the network's switching and transmission systems.

More than 150 of Optus' 1400 employees are at present located at the Sydney Technical Centre.

THIRD MOBILE PHONE CARRIER CHOSEN

The Federal Government has announced that the Arena GSM consortium has been chosen as Australia's third mobile telecommunications carrier. Arena will pay the government a total of $140 for this business opportunity, and is expected to place orders with local suppliers early this year for approximately $400 million worth of capital equipment, to establish its network superstructure. The consortium has offered a minimum of 60% Australian content in this superstructure.

Arena GSM has also undertaken to spend $1.2 million each year on training, and to allocate at least $1 million per year over the next five years to fund R&D on digital communications. The research will be carried out by a body established by Arena GSM, its suppliers and major Australian tertiary institutions, which will have a total five-year budget of $25 million.

In conjunction with Exicom Ltd, Arena GSM will also be undertaking 'pre-personalisation' of SIM (smart) cards in Australia. The smart card is central to the operation and security of the GSM digital handset, as it contains the individual operating and account details of each customer. This will be the first widespread application of smart card technology in Australia, and there is significant scope for expanding the use of SIM cards into areas such as Pay-TV and banking services.

SIXTH TV CHANNEL TO BE RESERVED

The Federal Government has decided to reserve permanent use of Australia's sixth vacant national TV channel for non-com-

UNSW SCIENTIST DEVELOPS ELECTRIC GRIPPER FOR SEMICON WAFERS

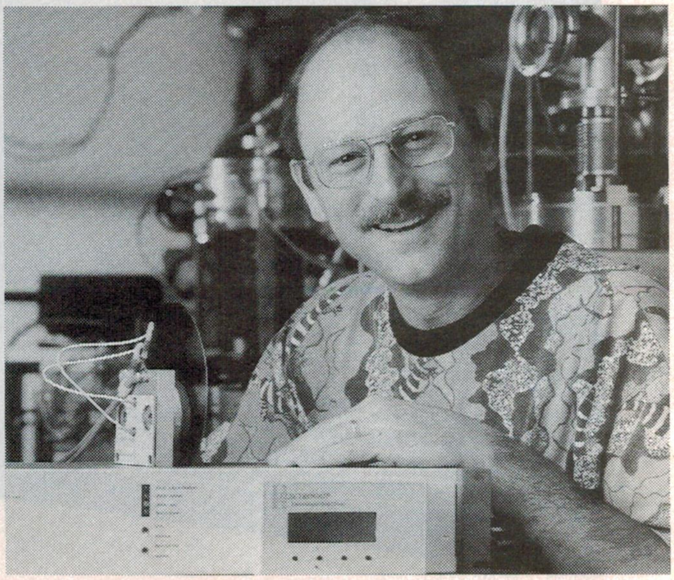
Fast and reliable manipulation of delicate semiconductor wafers is essential in the manufacture of modern ICs, and until now the only way to do this has been using mechanical methods. Systems using electric fields to 'grip' the wafers have been tried in the past, but have either caused chip damage due to penetration of the fields, or had other limitations.

However the shortcomings of earlier electrical wafer grippers have now been overcome, in a device developed by Dr Chris Horwitz, a Senior Lecturer in the University of NSW's School of Electrical Engineering.

Developed over a period of six years, with support from UNSW's Unisearch Ltd., Dr Horwitz's 'Electrogrip' device is now at the commercial stage and has created a great deal of interest from the US semiconductor manufacturing industry. Each Electrogrip unit sells for between US$5000 and $10,000, depending on size.

Dr Horwitz said Electrogrip and its market appeared to have matured simultaneously. "We cannot keep up with the demand for our units, and now that we have begun selling to some of the largest companies in the field, including one of the biggest chipmakers in the world, we think the market is about to take off", he said.

To handle the expected market and to be near his expected customers, Dr Horwitz now spends about eight months a year in the United States, working out of Pittsburgh. The project is about to get some development funding from the Pennsylvania state government, which has recognised the device's potential and wishes to retain Electrogrip's activities in that state.



Dr Horwitz and Electrogrip. (Photograph by Kevin Doig).

mercial purposes. Any decision on its permanent use will be made before, or as part of, a legislated review of the Australian TV industry to be undertaken before July 1, 1997.

The Government has asked the Australian Broadcasting Authority to allow community use of the sixth channel on a continuing trial basis, until a decision is made regarding its final use.

AUST GETS VIDEO 'BURST' TECHNOLOGY

American firm Instant Video Technologies has developed a patented 'burst' system for transmitting digitised video programmes in a fraction of their real-time duration, to minimise distribution costs. Called Instant Video, the technology will eventually allow users to access any video or film from their home or office, at the push of a button. Prototype systems have already demonstrated the ability to transmit two-hour movies over fibre-optic cables in as little as 10 seconds, but the technology will also operate using co-axial cable, microwave, satellite links and high capacity phone lines.

The new technology will shortly be available in Australia and Asia, as a result of a licence agreement signed between IVT and Melbourne firm Parsons Galloway Pty Ltd. PG Director Marco Marcou said his firm had conducted extensive market research over the last 12 months into the viability of Instant Video in the Asian and Australian markets, and is confident that this area is set to lead the world in acceptance of new information services.

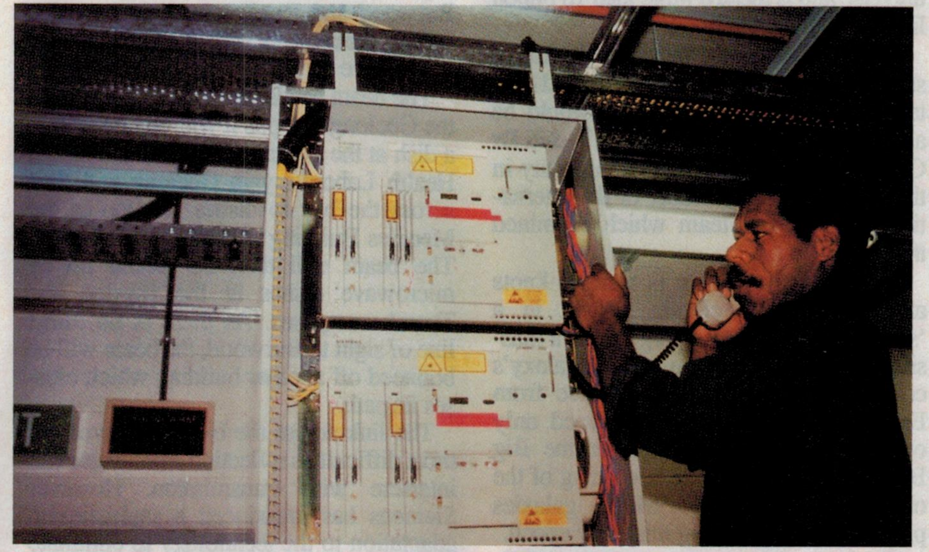
In addition to three US patents already issued (the most recent in November 1992), IVT also has additional patents pending for its technology in the US, Australia, Japan, Korea, the European community and other countries. The 'burst' transmission technology is expected to have applications in the health, education and business sectors as well as in home entertainment.

Further information is available from Parsons Galloway on (03) 662 1355.

SIEMENS TELECOMMS GEAR FOR PNG

Siemens has exported over $1,000,000 worth of telecommunications equipment to Post and Telecommunication Corporation of Papua New Guinea for use in the upgrade of its telecommunications network, and expects to continue this assistance and support throughout the current digitalisation program of its network and beyond.

Equipment supplied includes test equipment, fibre optic terminal equipment, distribution frames, equipment racks, connectors and cables — much of which is manufactured in Australia.



TOSHIBA FORMS FLASH ALLIANCES

Japan's Toshiba Corporation has formed strategic alliances with both National Semiconductor Corp. of the USA and Samsung Electronics of Korea, for the development of flash memory devices. The National Semiconductor partnership is for a period of five years, while that with Samsung is for eight years.

Both alliances cover the development of Toshiba's NAND flash EEPROM chip technology, which the firms expect to establish as a de-facto world standard. The agreement with NatSemi calls for Toshiba to transfer its proprietary EEPROM technologies, including process technology for 32Mb devices, to NatSemi so that the latter can design, manufacture and market the NAND chips worldwide. NatSemi also gets access to Toshiba's NOR-type flash technology as used in 1Mb and 4Mb devices.

The Samsung agreement also covers co-operation in the development of NAND-type flash EEPROM devices, for capacities of 16Mb and larger.

The worldwide market for flash memories is estimated at approximately 300 billion yen (roughly $3 billion) by 1995, rising to three times this figure by 2000.

AUST VERSION OF PC VIRUS

Melbourne computer virus expert Roger Riordan has identified a new 'strain' of an existing PC virus called 'Zerotime' (also known as 1716, Sydney and Slow), found in a NSW school. There is apparently evidence to suggest that the variant virus was modified in Australia.

The changes to the virus prevent most existing scanning software from detecting it, and one such scanning program has been found to effectively 'hide' it from detection by other scanners.

However Riordan has updated his own VET program so that the latest version 7.111 can both detect it and recover infected files. The new version also detects against several new viruses found overseas, and sells for $90.

Further information is available from Cybec, on (03) 521 0655 or PO Box 205, Hampton 3188.

PHILIPS WINS NEW $1M SWITCH ORDER

Philips Australia's Moorebank (NSW) facility has just won a $1,000,000 order from Hughes Aircraft Company to supply yet another consignment of microwave R-switches between March and September 1993.

This is Philips Defence Systems' ninth consecutive order for switches since its satellite facility was set up in 1988. It will mean that Philips Australia produced switches will be fitted in seven Hughes HS-601 communications satellite programs. The first switches manufactured at Moorebank are already operational in orbit on the first Optus satellite.

NEWS HIGHLIGHTS

HUBBLE SPOTS 'SPACE KNOTS'

NASA's Hubble Space Telescope (HST) has revealed a chain of 'luminous knots' in the core of the most distant known galaxy — one that existed in the infancy of the universe and is located more than 10 billion light years from Earth.

"These knots could be giant clusters of stars. If that is so, then each knot would contain about 10 billion stars and would be about 1500 light years across," said Dr George Miley of Leiden University in the Netherlands and leader of the international astronomer team which examined the galaxy.

An alternative theory is that the knots are gas or dust clouds, caught in a 'searchlight' beam of energy from a massive black hole hidden at the galaxy's core. The galaxy's great distance from Earth indicates that it was formed only one or two billion years after the Big Bang, which marked the beginning of the observable universe. Most galaxies probably formed during this early epoch.

The new photos, taken with the HST's wide field and planetary camera, reveal detail 10 times better than photographs previously taken with ground-based telescopes.

MICROWAVES LINK DEAKIN CAMPUSES

Deakin University in Victoria is to link its network of five campuses with a microwave beam which will traverse more than 70 kilometres across Port Philip Bay.

The University has signed a $200,000 contract with the telecommunication division of Siemens to install equipment which will dramatically increase communication capability between the campuses.

Craig Warren, Deakin Computer and Software manager said communication had become a major issue for the University. Following a series of institutional mergers the University had campuses which were five hours apart by road, and stretched from Warrnambool and Geelong in regional Victoria to the Melbourne suburban campuses of Toorak, Burwood and Rusden.

He said: "It is imperative that we have fast and reliable communication across the University. The microwave system is particularly suitable for our needs because it can carry voice, data and video."

Using technology developed by Siemens, a microwave beam will be used to transmit telephone calls and computer information between the campuses and will have a capacity equal to 500 simultaneous telephone connections. On each campus equipment will be used to convert telephone calls and computer data into a high frequency beam which will carry the messages between buildings.

Microwave dishes will be placed on the highest building on the Geelong, Toorak, Burwood and Rusden campuses to pick up and transmit messages relayed via the microwave beam.

The beam needs 'line of sight' and from the Geelong campus it will be bounced to a dish at the top of the Australian Animal Health Laboratory in Geelong and then across the bay to dishes on top of the Menzies Building at Monash University. The beam will then be picked up by microwave dishes at the Rusden and Toorak campuses. As there is no direct line of sight to Burwood, the beam will be bounced off another building which crosses its path.

The link across the bay has proved the most difficult as reflection from water can interfere with transmission. However Siemens has introduced a sophisticated adaptation to the technology to eliminate this type of interference.

The new Blaupunkt TC142 handheld cellular phone is claimed to be one of the world's smallest, measuring only 25mm thick and weighing in at 329gm. Despite this it offers many features, including 215 memories. It's handled in Australia by Robert Bosch (Australia), on (03) 541 5555.

IBM MAKING DISTECH'S WAREHOUSE OA SYSTEM

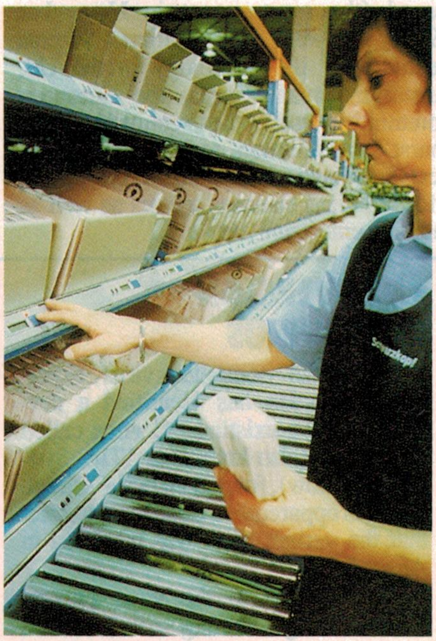
IBM's manufacturing plant in Wangaratta, Victoria, has completed an initial contract manufacturing order for an innovative Australian warehouse Order Assembly (OA) product designed by DISTECH. The product has been shipped to the USA for a pilot installation, under DISTECH's strategic relationship agreement with major materials handling and distribution systems supplier Interlake — parent company of Dexion. The Wangaratta plant is currently making a second unit for delivery to Canada.

Using the plant's surface mount technology, IBM Australia is manufacturing the picking face display — SmartFACE — for DISTECH's OA system. This is the key intelligent device which is distributed throughout the warehouse, to guide operators.

DISTECH Vice President, Sales and Marketing, David Light, said DISTECH's warehouse Order Assembly system uses advanced electronic technology and incorporates industry standard connectivity to systems operated by the user.

"SmartFACE virtually eliminates selection errors, and dramatically improves order processing and customer service in the warehouse environment," Mr Light said. "The DISTECH OA technology combines with the company's other products to provide a truly 'smart' and economical Warehouse Automation environment."

The product has now been accepted by large international organisations in Australia, Canada and the USA and is the basis of a significant export drive by the company."



NEWS BRIEFS

- ***Hayes Microcomputer Products*** has appointed Wayne Chan as its new General Manager for the Asia Region, which covers the Asian, Australian and Pacific Rim marketplace.
- To improve customer service in South East Asia, ***Marconi Instruments*** has established a regional sales, technical support and service facility in Singapore. UK staff Tony Rudkin and Ian McGuff have been appointed as Regional Manager and Sales Manager respectively. ❖

AUST-DEVELOPED CONTROL BY PHONE

Victorian firm Program Development Systems (PDS) has developed a telephone management system (called FONE MANAGER) which incorporates remote monitoring and control of digital I/O points around the home, office or factory.

The system uses an IBM-PC or 'compatible' computer together with a PC-IO-NR-12VAC real-world interface board from Procon Technology and PLCX (Extended Programmable Logic Control) software which runs in background on the computer and provides real-time control (time delays, counters, shift registers and any combination of logic functions can be programmed).

The demonstration system, installed in the office of PDS, provides eight digital inputs (12 Volts AC or DC) which monitor the security system and report over the telephone (using a voice generator) their current status or condition.

The system is capable of telephoning the police, giving address details, when an alarm occurs.

Furthermore, staff may be notified via telephone (or mobile phone) and be given the option to reset the system should a false alarm occur.

Also provided on this system is eight digital outputs (volt-free relay contacts) that are used to arm and disarm the alarm system, to turn the heating/cooling system on/off and other functions which may be added later; such as operating a sprinkler system.

Instructions may be automatically programmed using the PLCX software or operations may be initiated over the telephone via the numerical keypad of any telephone. The PLCX software also allows interlocks to be programmed; such that invalid operations cannot be carried out (e.g., turning the heating and cooling systems on at the same time).

PDS manager Mr Philip Bertolus said of the equipment supplied by Procon Technology that "Not only did it do exactly what was required, but it was easy to install and even easier to program."

Further information about FONE MANAGER can be obtained from PDS on (03) 563 3063. Information on the I/O boards and PLCX software can be obtained from Procon Technology on (03) 807 5660.

Germany is taking seriously the need for increased emphasis on fuel conservation and reduction in environmental pollution. As part of this effort, this computer controlled 'solar filling station' has been built in the south German town of Memmingen. Solar cells on the roof convert solar energy into current which is then fed into the station's 'pumps' to refuel electric cars.

TOSHIBA'S 160M COLOUR CRTS

Toshiba Corporation in Tokyo has celebrated a new world record for production of colour cathode ray tubes, as domestic production climbed to a cumulative total of 150 million.

Including units produced at the company's plants in the US and Thailand, Toshiba's record breaking total stands at over 160 million tubes.

Toshiba began mass production of colour CRTs in 1960, the year regular colour broadcasting started in Japan. The company quickly established leadership in picture tubes, which it has maintained through constant technological innovation.

Today, Toshiba is the world's largest supplier of colour tubes, with approximately 10% of the world market. Current production at its four production facilities stands at around one million units a month.

PHILIPS & INTEL JOIN FORCES FOR 8051

Philips Semiconductors and Intel Corporation have signed a strategic agreement to extend the architecture of the 8-bit MCS-51 microcontroller family.

This agreement between the two largest suppliers of 8051/80C51 microcontrollers ensures the continued longevity and standardisation of the architecture throughout this decade. Intel announced the first 8051 microcontroller in 1980 and Philips has been licensed to manufacture 8051 devices since 1984.

The agreement will result in a new family of products, based on an upgraded C51 core (code-named 'ZX'), that is fully instruction-set compatible with existing 8051 devices. These products are characterised by higher performance, expanded supply voltage, extended address range, high-level language support, fully static design and reduced noise generation. The new product will allow the designer to upgrade 8051-based systems while protecting his software investment.

The initial products resulting from the agreement are scheduled to be brought to the market place within 12 to 15 months, with the product being sold by both Philips Semiconductors and Intel Corporation. ❖

Advice from an experienced engineer:

Some thoughts on the design of Valve Audio Amplifiers - 1

Spurred on by the recent revival of interest in audio amplifiers using valves, one of Australia's most respected electronics engineers has agreed to offer *EA*'s readers the benefit of his wide experience in circuit design. Here's the first of two articles in which he discusses some of the pitfalls in designing a valve amplifier — and their solutions.

by NEVILLE THIELE B.E., F.I.E.(Aust.), F.I.R.E.E. (Aust.), F.A.E.S.

The advance of technology requires the creation of a whole host of new skills, but it also entails the atrophy and death of many old skills. Present day archaeologists have the greatest difficulty in determining how flint knives and arrow heads were made, and the skills needed for designing, operating and maintaining steam locomotives, and even valve television receivers, are dying fast.

But when no one outside a museum wants supplies of new flint arrow heads and fewer and fewer steam railways are going concerns, how can anyone devote his life or earn a living, learning and maintaining such skills?

So likewise while many of us had once taken pride in the finer points of design of valve audio amplifiers and their output transformers, it had seemed just a nostalgic indulgence to lament their passing. However, judging from observations during recent visits to Europe and the United States, and the article by Tean Y. Tan in the September and October 1992 issues of this journal, there is still a considerable interest in valve amplifiers.

Yet, after talking to some designers of modern valve amplifiers, it would seem that many do not know — or have forgotten — some of the stratagems that were well known several decades ago. (It has been said that in electronics, the wheel has to be reinvented every 25 years.) That is the excuse for writing the present article and setting down some considerations that may be unfamiliar, but could be of use, to present day designers of valve amplifiers.

I must admit from the beginning that I do not share the widespread(?) belief that valve amplifiers are in general superior to transistor amplifiers. It is difficult in any case to assess whether valve amplifiers, as a genre, are better than transistor amplifiers, as a genre. What we all of us must assess is whether, in the groups of amplifiers that we have heard, one group is in general better than the other.

The real test is whether the best valve amplifiers are better than the best transistor amplifiers, and that raises the question of how, in any case, we can assess what is best. The answer that 'my ears tell me' is not as simple or reliable as might at first appear.

Experience over the last 10 years, in subjective comparisons of new forms of audio and video transmission — analog and digital — has shown that for reliable assessment a great variety of programme material is needed, and that it cannot always be predicted what material is going to be the most critical.

The choice of methodology, especially the use of double-blind tests, to rule out the possibility (probability?) of listeners' prejudices is important, and

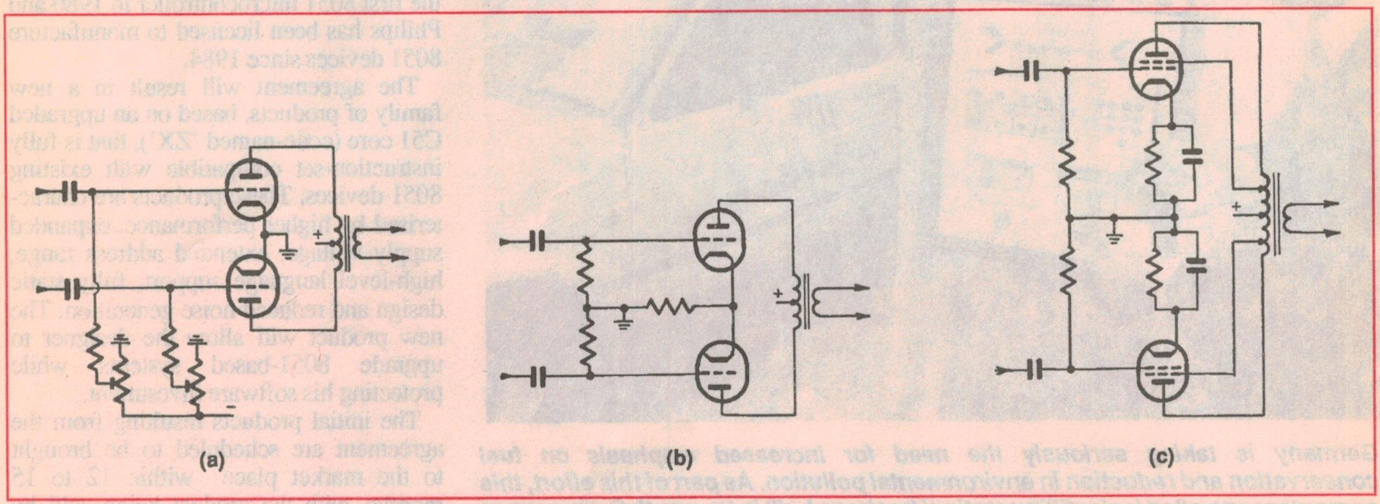


Fig.1: Biasing methods for push-pull output stages. Fixed bias is shown in (a), while (b) shows self bias with a common unbypassed cathode resistor and (c) self bias using individual bypassed cathode resistors.

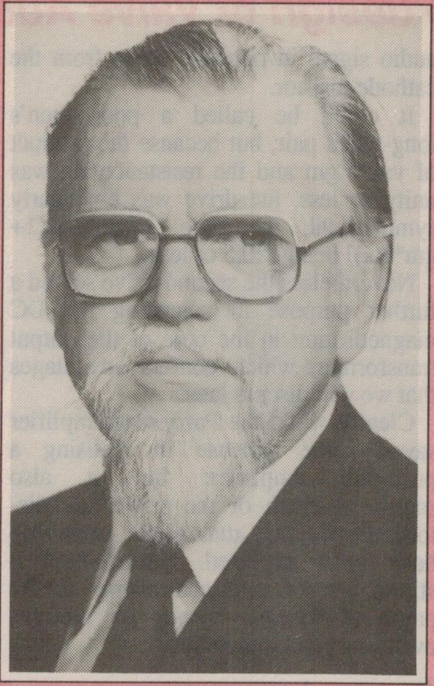
ABOUT THE AUTHOR

Albert Neville Thiele graduated from the University of Sydney in 1952, and for the following nine years worked at EMI (Australia) on the development of telemetry, radio and TV receivers, and electronic test equipment.

In 1962 he joined the Australian Broadcasting Corporation, where he designed and assessed equipment and systems for sound and television broadcasting.

In 1980 he became Director of the ABC's engineering research and development, until his retirement in 1985. He is at present a very busy consulting engineer in the fields of audio, radio and television.

Mr Thiele has published more than 30 engineering papers on loudspeakers, filters, equalisers and testing methods for sound and vision broadcasting — many of which have become accepted internationally as references on these subjects (such as those based on his work with Dr R.H. Small, on loudspeaker enclosure design).



A past President and Fellow of the IREE (Aust.), Mr Thiele is also a Fellow of IE (Aust.) and the Audio Engineering Society — of which he is also an International Region Vice President. He is also a Member of the SMPTE.

Currently he is an active member of the CCIR's Australian National Study Groups on Sound and Television Broadcasting and Long Distance Transmission, and Chairman of the Sound and Television Engineering and Recording Committee of Standards Australia.

Electronics Australia *is delighted that Mr Thiele was prepared and able to devote some of his valuable time to write the current articles, for the undoubted benefit of our readers.*

even then the need for a panel of listeners, preferably 20 or so, to devote hours to a fatiguing listening process, means that serious, reliable, comparisons of subjective quality are difficult, time consuming and expensive.

Certainly, the earliest transistor amplifiers were in general of poor quality. With their output stages biased back to a minimum of standing current so as to keep heating of their output transistors within safe bounds, they all too easily produced distressing crossover distortion.

Even when that was cured, they still produced non-linearity at high frequencies. This was initially known as TIM (Transient Intermodulation Distortion) but is better characterised and better understood as SID (Slew Induced Distortion). However, these mechanisms, and ways of avoiding them, are now much better understood, so that Professor Ed Cherry, for example, rates distortion ratios in good amplifiers in parts per million — that is, in small multiples of 0.0001%, or from 110dB to 120dB below full output.

It must be repeated that such figures apply only to well designed amplifiers, and of course simple total harmonic distortion measurements alone do not tell the whole story, as we saw from TIM and SID. However the purpose of this paper is to describe some of the less well-known features that contribute to good valve amplifier design.

It cannot be exhaustive (that would take a whole book), but it will try to set down considerations that are often overlooked, and may not be immediately obvious from reading the circuit diagrams.

Those will be illustrated by an amplifier which the author designed

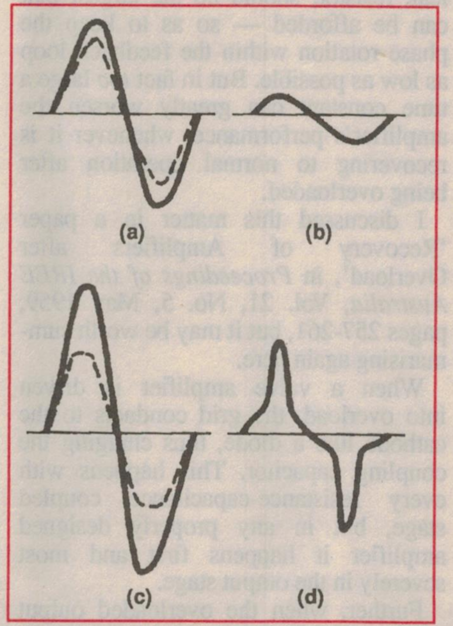


Fig.2: Amplifier voltages with negative feedback. The solid curve in (a) is the input signal in the undistorted condition, with the dashed curve the feedback; (b) shows the resultant difference signal fed to the amplifier input. For the distorted condition, the solid curve in (c) shows the input and the dashed curve the feedback; the resultant difference signal fed to the amplifier is as shown in (d).

for the EMI 'F series' television receiver in 1957.

This amplifier laid no claim to full 'high-fidelity' status, but aimed at giving genuine quality at the lowest possible cost. Apart from the need for an additional 40mA of HT current, which added little to the 300mA drawn by a valve television receiver of the period.

Similarly the factory cost of this push-pull amplifier was only 15 shillings more than a conventional single-ended sound output stage. Its 6-watt maximum output may seem small by present day standards, but was ample for loudspeakers of the time — which had lighter cones and were generally 10dB more efficient than today's. Thus their acoustic output was similar to that of present day loudspeakers with 60-watt amplifiers.

Self bias vs. fixed bias

Experience had shown that valve amplifiers for domestic use should always use *self bias*, rather than fixed bias. With fixed bias, as in Fig.1(a), somewhat more power can be obtained; but as valves age their emission falls, and unless a valve amplifier is tended at regular intervals by a trained technician, as for example in a broadcasting station, the performance deteriorates — slowly and insidiously.

Besides, when the fixed bias is adjusted with potentiometers, it invites later tinkering and thus mis-setting. For these reasons self bias is, to my mind, worth the comparatively small loss of output power compared with fixed bias.

Some thoughts on the design of Valve Audio Amplifiers - 1

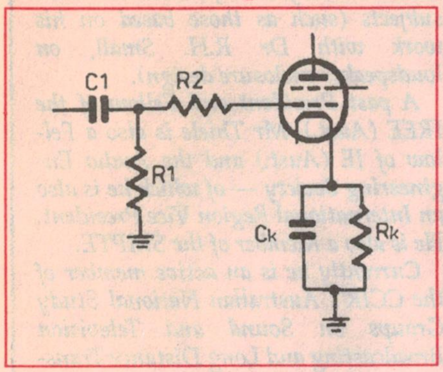


Fig.3: The basic coupling circuit components, involved in the mechanism whereby an amplifier can be 'paralysed' following an overload.

In a self biased push-pull amplifier, it was usual to connect the two cathodes together with a single resistor to earth without a bypassing capacitor, as in Fig.1(b). The reason was that the cathode current variations due to the audio signal are of equal magnitude and opposite sense, so they produce no nett audio signal in the single resistor, which therefore needs no bypass capacitor. However, this defeats some of the advantages of self- bias.

If one valve of a push-pull pair ages faster than the other and draws less cathode current, the use of a common cathode resistor, which tends to keep the total current constant, would make the other valve draw excessive cathode current.

This exaggerates the difference between them and makes the better valve age more quickly. It also affects the symmetry of the push-pull output and unbalances the DC magnetising current in the output transformer, making it much less capable of handling large low-frequency signals.

For this reason, I have preferred to use two separate cathode bias resistors, each with its own bypass capacitor, as in Fig.1(c). This is a little more expensive, but much better able to maintain its performance over time.

The best compliment to this scheme was paid by a service technician, who complained that in this amplifier it was much harder to tell by ear if one of the output valves had failed!

There was, of course, the Parry Cathamplifier featured in the late thirties in *Wireless Weekly*, the precursor or progenitor of *Electronics Australia*. In its output stage, the cathode resistor was left unbypassed, as in Fig.1(b), and the grid of the second valve was simply connected to earth, so that it derived its audio signal in opposite sense from the cathode resistor.

It could be called a poor man's long-tailed pair, but because the product of valve gm and the resistance R_K was unity or less, the drive was not nearly symmetrical, the ratio 1:[gm*R_K/(1+ gm*R_K)] being 1:0.5 or less.

Nevertheless the second valve served a further purpose in balancing the DC magnetisation in the core of the output transformer, which confers advantages that we will discuss later.

Clearly while the Parry Cathamplifier saved some expense in realising a push-pull amplifier; but it also sacrificed much of the power and distortion reduction that might otherwise have been expected. Nevertheless it stirred interest and controversy in the pages of *Wireless Weekly* for months, even years as I remember.

Overload recovery

Another topic that has never received the attention that it deserves is the choice of time constants in the coupling networks. At first sight, it might seem that the coupling capacitor, and hence its time constant with the following grid leak resistor, should be the largest that can be afforded — so as to keep the phase rotation within the feedback loop as low as possible. But in fact *too* large a time constant can greatly worsen the amplifier's performance, whenever it is recovering to normal operation after being overloaded.

I discussed this matter in a paper 'Recovery of Amplifiers after Overload', in *Proceedings of the IREE Australia*, Vol. 21, No. 5, May 1959, pages 257-261, but it may be worth summarising again here.

When a valve amplifier is driven into overload, the grid conducts to the cathode like a diode, thus charging the coupling capacitor. This happens with every resistance-capacitance coupled stage, but in any properly designed amplifier it happens first and most severely in the output stage.

Further, when the overloaded output voltage is clipped, the negative feedback voltage, as in Fig.2, is clipped likewise and — for the time that this clipping persists during each cycle — the effective input to the amplifier, which is the difference between the input voltage and the feedback voltage, rises rapidly by an amount equal to the feedback factor.

With 20dB (i.e., 10 times) negative feedback, the feedback voltage will normally be 0.9 times the voltage at the input terminals, so that 0.1 times the input terminal voltage is fed to the amplifier. But while the feedback voltage is clipped, the whole increment of the input terminal voltage — 10 times normal on the peaks — is fed to the amplifier. This greatly increases the drive voltage, and the coupling capacitor charges even more rapidly.

When the excessive input signal is removed, the output stage remains misbiassed by the excess voltage stored in the coupling capacitor (C1 in Fig.3), and the amplifier will continue to distort, even when the output signal is comparatively small, until C1 has discharged through the grid 'leak' resistor R1. A secondary effect is that on overload the cathode current rises also, charging Ck to an excessive value until it also has discharged through R_K.

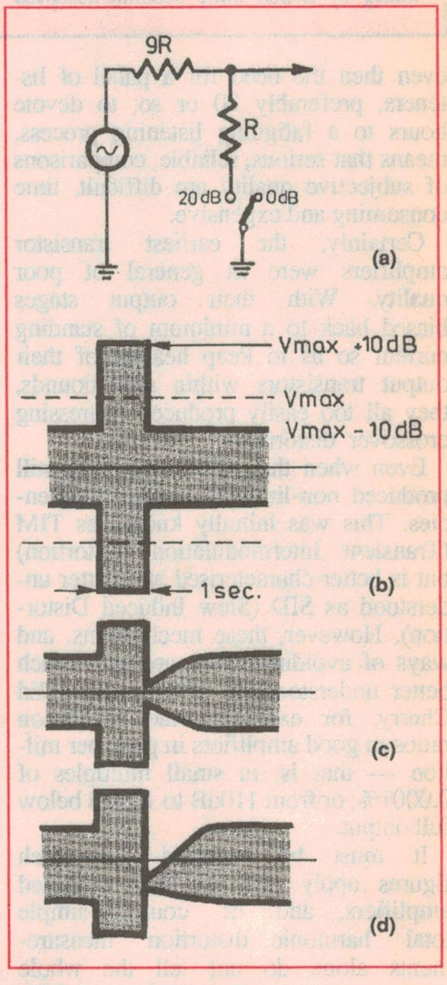


Fig.4: A test used to reveal the extent to which the amplifier becomes 'paralysed' following an overload. (a) shows a switchable 20dB attenuator, (b) the amplifier input voltage, (c) and (d) the output voltage of typical amplifiers.

Obviously the larger these time constants, the longer will distortion persist after every overload, however short. Thus the use of a 470nF coupling capacitance C1 with a 470k grid leak will take at least 0.22 second to discharge. However for many purposes a 15nF coupling capacitance is ample. With a 470k grid leak, it produces a time constant of 0.007 seconds, and will obviously recover much quicker. It introduces into the open loop gain of the amplifier an amplitude response of -3dB and a phase rotation of 45° at 23Hz.

The paralysis of an amplifier after overload can be further reduced by increasing the resistance of the 'grid stopper' (R2 in Fig.3) — thus slowing down, and greatly reducing, the charging of C1 during overload. The stopper resistance, conventionally set around 10k, can advantageously be increased to a figure about equal to R1 — i.e., 470k in the example above.

When this was done in the amplifier using push-pull 6BM8's referred to above, the result was dramatic. With C1 at 470nF, R1 at 470k and R2 at 10k, distortion could be heard at the same time as clipping started to be visible on an oscilloscope display. But with C1 at 10nF, R1 at 470k and R2 at 470k, the amplifier could be driven 3dB harder, with highly visible flattening of the peaks, before serious distortion became audible.

The reader may be unwilling to accept such a result. The test, undertaken 36 years ago, was short and in no way exhaustive, with only five observers, and the increase in 'music power' may not have been precisely 3dB. Nevertheless the improvement was beyond all possible doubt.

The fact that such comparatively severe distortion on occasional peaks can occur without being heard is not at all surprising when one considers what happens in tape recording.

The specifications for analog tape recorders of the highest broadcast quality allow 2% distortion at 8dB above Alignment Level, defined as the level of tone that reads 0dB on a VU meter. American specifications were lower, allowing 3% distortion at 6dB above Alignment Level.

Yet true peaks in audio signals go much higher, the degree depending on the programme material, but going as high as 12dB, 16dB, even 18dB above Alignment Level for digital transmission.

The ear clearly does not discern short bursts of distortion on these peaks so long as the momentary overload, as in a tape recording, does not paralyse the system and give rise to distortion that continues for tens, or hundreds, of milliseconds afterwards.

Paralysis can easily be detected by a valuable IEC test, illustrated by Fig.4, in which an input tone signal is fed to an amplifier through a switchable 20dB attenuator.

With the 20dB attenuation in circuit, the amplifier is brought to within 10dB of clipping. The attenuation is then switched out so that the amplifier input is driven 10dB beyond the clipping level. Then, after one second, the 20dB attenuation is restored and the output voltage observed on an oscilloscope.

The paralysis and slow recovery of the output signal can be seen on all but the best amplifiers. Sometimes the centre line of the output shifts as well, corresponding to a superimposed DC transient. This happens with both valve and transistor amplifiers, and the test is essential for both. It is of special interest in valve amplifiers because it can be minimised easily, by design procedures that actually reduce the cost.

However, a warning. When an output stage is fed through large grid stoppers, or indeed any high impedance circuits, there is a danger with some valves of producing a disturbing 'rattle' at outputs approaching near maximum.

Valve manufacturers tracked this down to the accumulation of charges on the glass wall — inside, of course — when some electrons, accelerated from the cathode, pass through holes in the sheet metal of the anode and strike the glass.

These electrons, in fact, produce the characteristic light blue glow often seen on the clear glass of a power valve with a good vacuum — not to be confused with the purplish glow that appears within the volume of a valve whose vacuum has been 'spoiled' by the accumulation of gas.

The valve manufacturer averred that the voltage built up on the wall by these charges could sometimes break down during the output cycle and thus produce a small pulse by capacitive coupling to the control grid, especially when its AC impedance to earth was high. Whatever the reason, an oscilloscope would show a tiny pulse near the peak of a sine wave test signal, accompanied by the characteristic audible 'rattle'.

It occurred in only a few valves, but could be a nuisance in quantity production. One wonders of course whether the powdered carbon coating on the walls of such valves as 6V6, 6L6, KT66 and KT88 was put there to conduct such charges away.

(To be continued) ❖

Locally made UHF CB:

Acclaim for GME's new TX4000

Australian manufacturer Standard Communications has achieved well-deserved acclaim for its new GME Electrophone TX4000 UHF CB transceiver. Fully designed and manufactured at the firm's plant in Gladesville, Sydney, the product takes full advantage of the latest digital and surface-mount technology.

When Australia introduced its UHF CB communications band back in 1978, it presented local manufacturers with a great opportunity to exploit the market thus created. And one of the firms that moved to take advantage of this opportunity was 'true blue' Aussie firm Standard Communications, which has been steadily developing its expertise in local manufacture of radio communications and TV RF distribution equipment during its entire 34-year history.

Led by managing director Ted Dunn, Standard Communications has quietly established what is undoubtedly one of the most efficient and up-to-date electronics design and manufacturing plants in Australia — one that compares well with anything overseas, and at the same time is carefully 'focused' on producing the products and volumes for its target markets. It has a team of highly trained engineers, who take advantage of the latest computer-aided design tools, and has also invested heavily in state of the art production plant — including automated SMT pick and place machines, computer-driven production test systems for both PCB assemblies and completed units, and computerised stock control and production planning systems.

Happily this investment and hard work has paid off. The company's locally designed and manufactured products, marketed throughout Australia and overseas under the 'GME Electrophone' and 'Kingray' brandnames, are now firmly established as leaders in their market areas. It has also achieved considerable success with distribution of complementary products from firms such as Fuso and Garmin.

The firm's latest UHF CB transceiver, the TX4000, is an excellent example of its capabilities and achievements. Although very compact (only 171 x 52 x 143mm), the TX4000 takes full advantage of modern digital microprocessor and SMT technology, offering a range of features and facilities — together with a level of reliability and design elegance — which compare with anything available from overseas.

Facilities on the TX4000 include microprocessor-controlled frequency synthesis, integrated multi-tone selective calling for essentially 'private' and interference-free communication (5-tone CCIR compatible), high speed programmable scanning, extensive mode and selcall memory capabilities, and the ability to operate in duplex mode for more convenient repeater operation.

It also features a clearly visible LCD display panel with adjustable backlighting and bar-graph signal strength indicator, rotary pulse switch channel selector for greater convenience and reliability, a high performance electret microphone and forward-facing speaker for high intelligibility. It can also be supplied in either a single case for underdash mounting, or as a separate control panel and remotely-fitted box configuration.

The TX4000 operates on all 40 channels in the Australian UHF CB band (476.425-477.400MHz), and its transmitter provides the maximum legal RF power output of 5W. The receiver is a double-conversion superhet with a rated sensitivity of 0.3uV for 12dB SINAD, a selectivity of +/-25kHz at -65dB, and an audio power output of 3W. Frequency stability of both sections of the TX4000 is better than +/-5ppm.

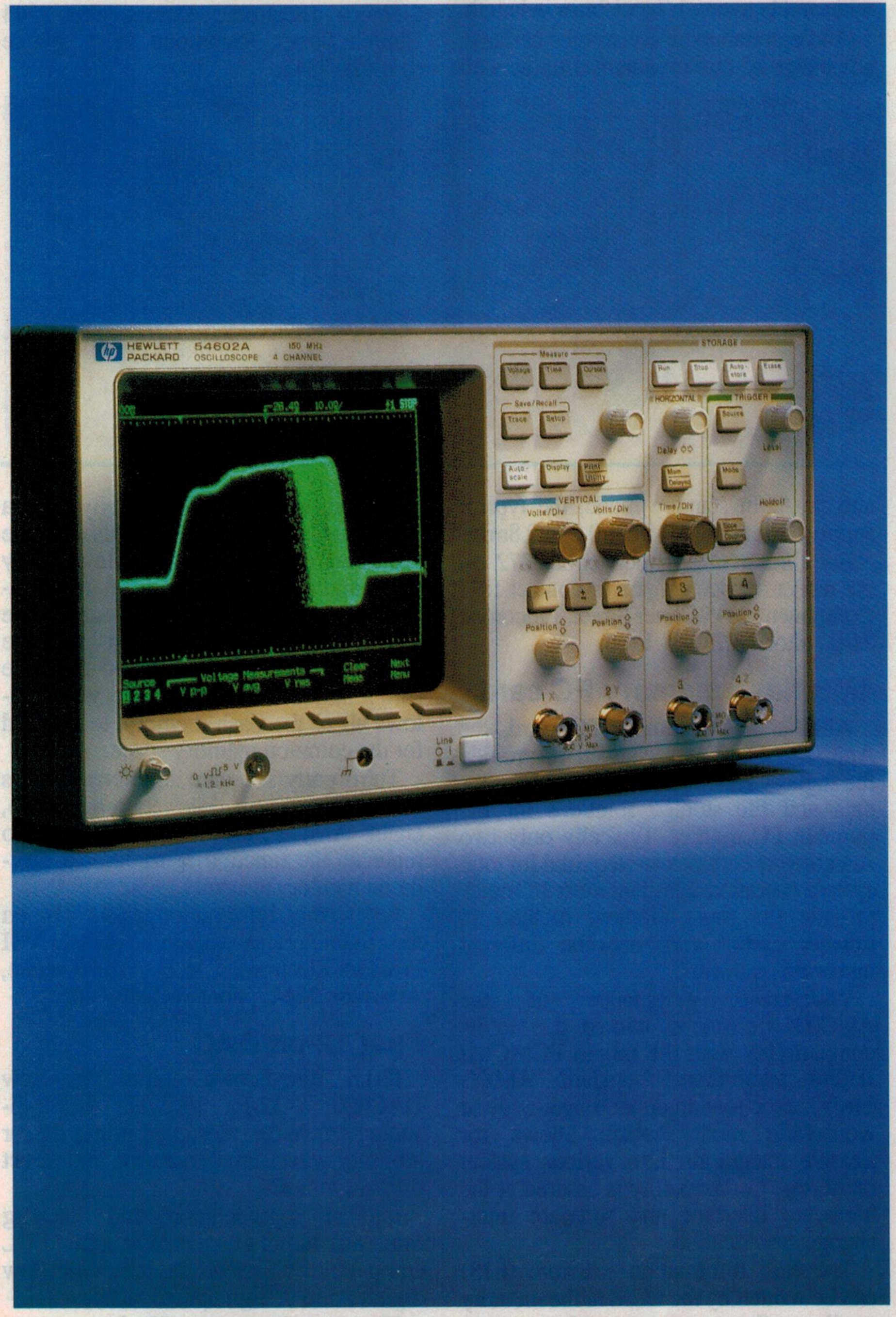
This impressive range of features has apparently gone over very well indeed with UHF CB users, and large numbers of TX4000's are now being used by professional organisations, small and medium sized businesses, farmers and Government agencies.

As with all of Standard Components' other products, the TX4000 is available from and supported by a network of selected specialist dealers around Australia.

Further information regarding either the TX4000 or the location of your nearest GME Electrophone dealer is available from Standard Communications at 6 Frank Street, Gladesville 2111 or phone (02) 816 4755. (J.R.) ❖

FFT and a scope for under $5,500

You Didn't Think You Could Afford HP, Did You? Think Again.



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The HP54600 gives you superior viewing of virtually any waveform, even at low rep rates and slow sweep speeds. It looks and feels like an analog scope, with dedicated knobs and a display that responds instantly to your control changes. And it has the digital power that analog can't give you – high accuracy, automatic measurements, hard copy output and programmability.

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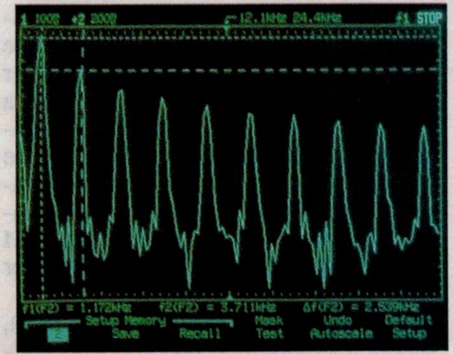

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Two-channel X-band module

MITEQ has introduced a two-channel multifunction assembly for low noise radar receiver applications. Each channel of the MIC consists of a 20dB directional coupler and a low noise amplifier. Channel selection is made by a single pole, two throw switch connected to the outputs of amplifiers. Test signals can be injected into both inputs simultaneously via an integral power combiner connected to 20dB couplers.

The unit operates over an eight to 11GHz frequency range, with a maximum noise figure of 1.5dB and insertion gain of 30dB minimum. VSWR does not exceed 1.5:1 and the unbalance between two channels is +/-0.25dB and +/-4° maximum. Isolation between the channels exceeds 55dB.

For further information circle 271 on the reader service coupon or contact Electronic Development Sales, PO Box 822, Lane Cove 2066; phone (02) 418 6999.

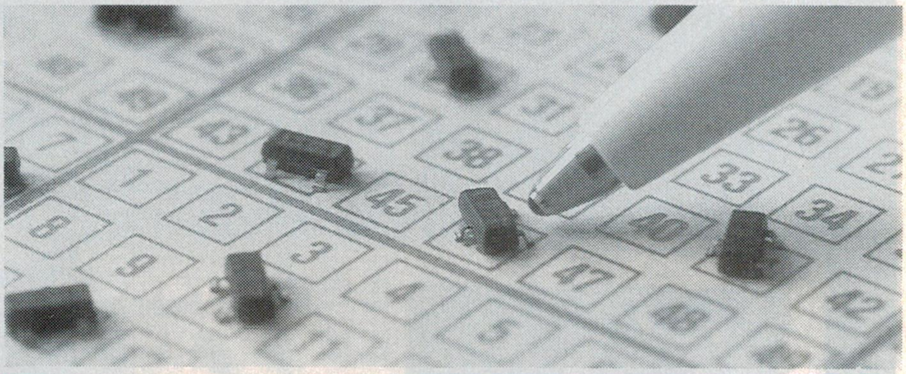
Mini components for mobiles

The new SOT 323 and SOD 323 surface-mountable, super-miniature component packages have high-frequency components (transistors and diodes) supplied by Siemens which are only 1.25mm wide and between 1.7 and 2mm in length.

And entertainment electronics can take advantage of this miniaturisation as well as mobile radio. Siemens is the first company in Europe to supply tuner diodes of this design.

The components are also available on 8mm tape for series equipment production.

For further information circle 273 on the reader service coupon or contact Siemens Electronic Components, 544 Church Street, Richmond 3121; phone (03) 420 7345.



Voice coil driver IC

Siliconix has released a voice coil motor (VCM) driver IC with complementary MOSFET outputs. Compared with any other available solutions, the new IC uses less power and has a lower standby current, while providing a higher level of integration for magnetic and optical disk drive applications.

Designed to replace discrete components such as a motor current sense amplifier, loop compensation amplifier and power amplifier, the Si9961CY is a 12V, 1A VCM driver IC offered in a 24-pin surface mount package. The device combines complementary N and P-channel MOSFETs in an H-Bridge configuration designed to drive the type of VCM typically found in a 3-1/2" magnetic or optical disk drive.

The Si9961CY provides gain-select, head-retract circuitry, and a system voltage monitor with fault output. Output crossover ensures no cross-conduction. The combination of the interface, power, and protection circuitry reduces the total component count for greater board-space savings and higher system integration. For RETRACT and ENABLE (low), normal supply current is respectively 2mA and 5mA. In standby mode, the typical supply current ranges from 0.2 to 0.8mA.

For further information circle 272 on the reader service coupon or contact IRH Components, 1-5 Carter Street, Lidcombe 2141; phone (02) 364 1766.

4MB flash memory PC card

AMD's Flash Memory PC Card, the AmC004AFLKA, is claimed to provide the highest system level performance for data and file storage solutions for the portable PC market. Typically only two AA alkaline batteries are required for total system operation. Flash memory PC cards provide the most efficient method to transfer useful work between different hardware platforms.

Widespread acceptance of the AmC004AFLKA is assured due to its compatibility with the 68-pin PCMCIA/JEIDA international standard. AMD's cards can be read in either a byte-wide or word-wide mode, which allows for flexible integration into various system platforms. Compatibility is assured at the hardware interface and software interchange specification.

The card information structure (CIS) can be written by the OEM at the memory card's attribute memory address space (beginning at address 00000H) by using a format utility. The CIS appears at the beginning of the card's attribute memory space and defines the low level organisation of data on the PC card. The AmC004AFLKA contains a separate 512-byte EEPROM memory for the card's attribute memory space which allows all of the flash memory, to be used for the common memory space.

Third party software solutions such as Microsoft's Flash File System (FFS), enable AMD's Flash Memory PC card to replicate the function of traditional disk-based memory systems.

For further information circle 274 on the reader service coupon or contact VSI Promark Electronics, 16 Dickson Avenue, Artarmon 2064; phone (02) 439 4655.

Fast 12-bit DAC

From Burr-Brown comes the new DAC600, a 12-bit 256MHz digital-to-analog converter, designed primarily for arbitrary waveform generation and direct digital synthesis.

Internal segmentation and latching minimise output glitch energy, while ECL compatibility assists in achieving low digital noise at high update rates.

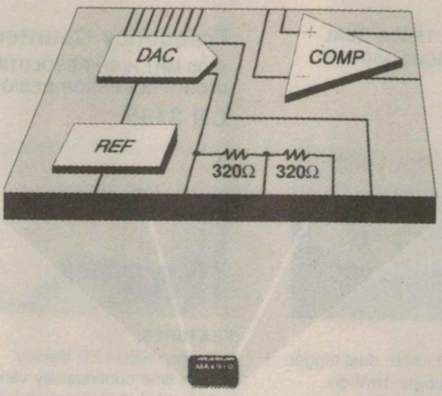
The complementary 50-ohm outputs

and low output capacitance simplifies transmission line design and output filtering. In addition, the DAC600 has an internal multiplying reference input with a bandwidth of 10MHz. This wide bandwidth feature makes it very useful for AM modulation, full scale adjustment, dithering, etc.

The DAC will be offered in two grades and will be on short delivery for small quantities. It will also be produced in die form. In standard form it is packaged in a 68-pin quad LCC package. A demonstration board will be available which will enable customers to quickly check out the suitability of the DAC600 and which can also be used as a goods inwards inspection device. Users will need to provide high speed 12-bit words to the demo board in order to test the part.

For further information circle 276 on the reader service coupon or contact Kenelec, 48 Henderson Road, Clayton 3168; phone (03) 560 1011.

4ns comparator has digital threshold



Maxim's new MAX910 and MAX911 ultra high-speed comparators include a high speed 8-bit DAC and voltage reference to rapidly set the input threshold voltage of the comparator. The MAX910 is TTL compatible with an 8ns propagation delay, while the MAX911 is ECL compatible with a 4ns delay. The comparator's threshold level, set by the DAC, has 10mV resolution and is digitally updated through its full scale range in only 50ns.

By combining a comparator, voltage reference, and an 8-bit DAC in a single IC, the MAX910/ MAX911 reduce board space requirements by a factor of 10 and power consumption by a factor of 5.

For high speed comparator applications where the threshold voltage must be updated rapidly, such as automatic test equipment (ATE) or process control applications, the MAX910 and MAX911 provide a complete, single IC solution which reduces stray capacitance, board space, design time and cost over multichip, discrete solutions.

For further information circle 277 on the reader service coupon or contact Veltek, 18 Harker Street, Burwood 3125; phone (03) 808 7511.

600V, 57A MOSFET

To satisfy increasing power diversity requirements, Advanced Power Technology is introducing upgraded versions of their Isotop range of power MOSFETs. The range now offers devices from 200V at 12A (APT20M21JN) through to 1000V at 33A (APT10026JN). The APT60M90JN offers a 600V capability to 57A continuous at 25°C. Features include a 2500V chip-to-case isolation and a 0.18°C/W junction to case thermal transfer.

The 'Jumbo' sized chip used in the range is claimed to be the largest produced, and replaces the four devices traditionally used in this case outline. Input capacitance is minimised and thus device switching speeds are improved.

Applications for the Isotop range include switching power supplies, DC-DC converters, motor controllers, welders and high voltage DC switches.

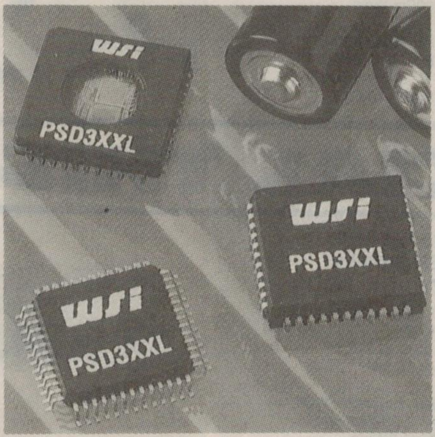
For further information circle 278 on the reader service coupon or contact RVB Products, 23 DeHavilland Road, Braeside 3195; phone (03) 580 0688.

3V microcontroller peripheral ICs

WSI (formerly WaferScale) has released its PSD3XXL family of low voltage, single chip, field programmable microcontroller peripheral ICs.

The chips were developed to meet the low power requirements of battery-operated products such as laptops, palm tops, medical instrumentation, cellular phones, hard disk drives and portable test/measurement devices. The six-member PSD3XXL family operates between 3V and 5.5V, has an operating current as low as 1.0mA and a standby current rated at 0.5uA.

By providing all the logic, paging, SRAM, EPROM and latches in a single 3V device, the PSD3XX family meets a critical need for small system size and lower power consumption. Currently, because of a lack of 3V peripherals, low voltage designs tend to be either mixed-voltage designs, or all parts must operate at the voltage of the highest voltage component. The total chip count of such a



design can be as high as 14 devices. The PSD3XXL ICs interface directly with any 8-bit or 16-bit, 3V or 5V microcontroller on the market, enabling the design of a completely 3V embedded control solution using only two chips.

For further information contact WSI, 47280 Kato Road, Fremont, CA 94538, USA; phone (USA) 510 656 5400, fax (510) 657 5916.

Surge protected ignition coil drivers

Motorola has developed a series of 'smart' power devices that automatically clamp spikes in automotive ignition systems and guard against Electrostatic Discharge (ESD).

Designed primarily as ignition coil drivers, the devices feature a logic level insulated-gate bipolar transistor (IGBJT) with integral active collector clamp and ESD gate protection.

The new devices can withstand high current in a pulse mode without latching, a key factor in ignition systems. They will be available in two voltage ratings, 350V and 400V, with a maximum continuous current rating of 20A and 16A.

The devices are standard power MOSFET processing to avoid the high cost of mixed process power IC technology. The IGBJT ignition driver uses polysilicon diodes to provide a precise, temperature compensated, active clamp to limit inductive flyback voltage spikes that are generated from switching the ignition coil.

The active clamp turns the IGBJT back on during the time that the inductive spike would normally exceed the breakdown of the device. This allows the entire cross-sectional area of the device to absorb the excess energy in the forward bias mode and increases the energy handling capability — thus preventing the device from going into destructive avalanche.

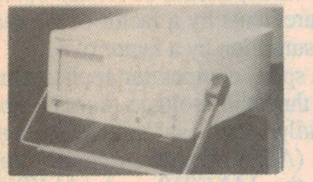
Polysilicon diodes are also used on the gate to improve the ESD capability to over 2000V, while still providing a logic level (3-5V) activation capability. ❖

SAMPO

THE NAME THAT MEANS QUALITY

20 MHz DUAL TRACE DUAL TRIGGER DIGITAL STORAGE OSCILLOSCOPE

SSI-2325



FEATURES:
- Anolog and digital in one.
- Maximum Sampling Rate 10Ms/sec.
- Equivalent Sampling BW 20MHz.
- Dual trace, Dual trigger, X-Y OP.
- High sensitivity 1mV/div.
- 2 x High Quality Probes.

$1050 + TAX

60 MHz DUAL TRACE DUAL TIMEBASE OSCILLOSCOPE

SSI-2360

FEATURES:
- 60 MHz dual trace, dual trigger.
- Vertical sensitivity 1mV/div.
- Maximum sweep rate 5ns/div.
- Built-in component tester.
- With delay sweep, single sweep.
- 2 x High Quality Probes.

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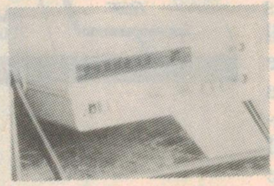
Frequency Counter

1000 MHz HIGH RESOLUTION MICROPROCESSOR DESIGN

CN 3165

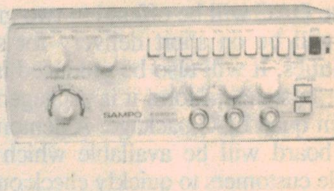


FEATURES:
- 8 digits RED LED display.
- Gate time continuously variable.
- At least 7 digits/second readout.
- Uses reciprocal technique for low frequency resolution.

$285 + TAX

Function Generator

2 MHz VCF, PULSE, SWEEP



FEATURES:
- Sine, Triangle, Square, Ramp.
- Output 20Vpp.
- TTL or CMOS.
- 10mSec—10sec.

$230 + TAX

LODESTAR

MODEL: SG-4162AD **$375**

RF SIGNAL GENERATOR/COUNTER

GENERATOR:
Freq. Range 100KHz-150MHz in 6
Ranges: RF Output 100m Vrms; Modulation Int. 1KHz(30%), Ext. 50Hz-20KHz; X'tal OSC 1-15MHz(HC-6U).

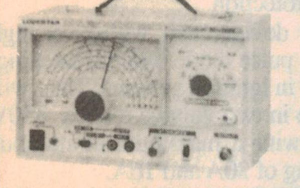
FREQ. COUNTER
Freq. Range 10Hz-150MHz;
Gate Time 1S,0.1S;
Accuracy ± 1 Count;
Sensitivity 35m V-50mV (10Hz-150MHz).

MODEL: AG-2603AD **$370**

AUDIO GENERATOR/COUNTER

GENERATOR
Freq. Range 10Hz-1MHz; Wave Form Sine/Square; Output Level Sine: 8 Vrms, Square: 10 Vp-p; Attenuator 0, -20dB, -40dB and Fine Adjuster.

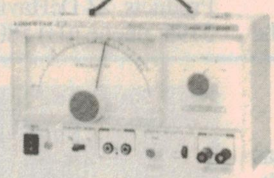
FREQ. COUNTER
Freq. Range 10Hz-150MHz;
Gate Time 1S,0.1S;
Accuracy ± 1 Count;
Sensitivity 35m V-50mV (10Hz-150MHz).



MODEL: SG-4160B **$210**

RF SIGNAL GENERATOR

Freq. Range	100KHz-150MHz in 6 Ranges
RF Output	100m Vrms
Accuracy	± 3%
Modulation	Int. 1KHz(30%) Ext.50Hz-20KHz
Xtal OSC	1-15MHz(HC-6U)
Attenuator	Hi Lo(-20dB)



MODEL: AG-2601A **$210**

AUDIO GENERATOR

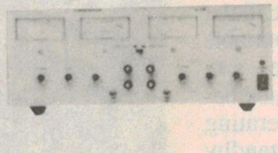
Freq. Range	10Hz-1MHz
Accuracy	± 3%
Wave Form	Sine/Square
Output Level	Sine: 8 Vrms Square: 10Vp-p
Attenuator	0, -20dB, -40dB and Fine Adjuster

ON SPECIAL THIS MONTH

MODEL: 8203(5A) **$550**

DIGITAL POWER SUPPLY (DUAL OUTPUT)

- Output Voltage 0- to 30V with Fine Adjuster; Output current: 0 to 5A
- Load Regulation 0.02% + 3mv;
- Line Regulation 0.02 + 3mv
- Noise and ripple
- Protection Over Load and Short circuit; (Indication 3½ Digit LED Meter X 4)
- Accuracy ± 0.05% — 2 Digit:



MODEL PS 303D **$375**

POWER SUPPLY (Dual Output)

- Output Voltage 0 to 30 volts
- Output current 0 to 3 Amps
- Ripple 0.5mV Rms
- Overload & Short "CCT. Prot"

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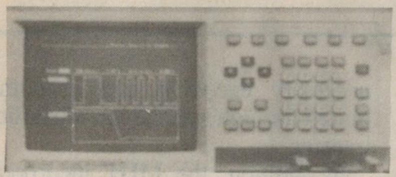


HP54201D

OSCILLOSCOPES

Tektronix 7603 100 MHz Dual Trace	$1,250
Tektronix 7613 100 MHz Dual Trace Storage	$1,350
Tektronix 7623 100 MHz Dual Trace Storage	$1,475
Tektronix 422 15 MHz Dual Trace Portable	$320
Tektronix 7623 100 MHz Dual Trace Storage	$1,475
Tektronix RM7903 500MHz 3 Slot Main Frame	$1,400
Hewlett Packard 1707B 75 MHz Dual Trace Portable	$875
Hewlett Packard 54201D 300 MHz DSO/Logic Analyser List 18K$	$3,750
Hewlett Packard 54503A 500 MHz DSO 4 channel	$4,500

ATTENUATORS

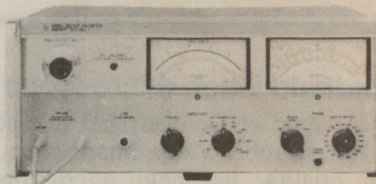
HIGH POWER

BIRD 8325

Bird 200W 30dB 8322 List $1550	$845
Bird 500W 30dB 8325 List $2050	$1025
Narda 150W 6dB 6GHz	$220
Emco 20W 10dB 1.5GHz	$45

SUPER SPECIAL

Narda 3dB SMA M/F 12.4GHz (New)	$30
Narda 10dB SMA M/F 12.4GHz (New)	$38



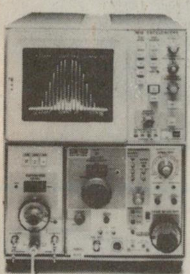
HP. 8405A

VOLTMETERS

H.P. 8405A Vector to 1000 MHz	$900
H.P. 3400A A.C. True RMS	$250
H.P. 400E/EL Millivolts/600Ohm	$250
Fluke 8575A 5.5 digit Nixie D.M.M.	$275
H.P. 7623A Log Voltmeter	$225

MISCELLANEOUS

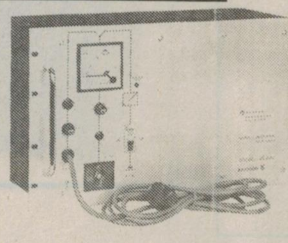
Telonic 0→10dB 18GHz x 1dB Attenuator	$175
Codan 7815 HF Tranceivers 50w	$300
Codan 6801 HF Tranceivers 100w	$475
Yaesu FM 1540A VHF Tranceivers	$175
Tektronix Lab Cart 3 Trolleys	$275
Mitsubishi Video Printer	$200
Data Products 132 col. Printer	$75
H.P. 8640B 500kHz→512MHz Sig Gen.	$3,950
Tektronix 1502 Cable TDR	$4,250
H.P. Crystal Detectors 18GHz	$230
Dow Key Coax Relays "N" (New)	$50
H.P. 1300A 14" X.Y. Display	$100
Systron Donner 801 Audio Spec An.	$400
Marconi 1245 "Q" Meter	$650
AWA MTS A211 Audio Analyser	$300



TEK 7L13

SPECTRUM ANALYSERS

H.P. 182C + 8558B 0.1→1500MHz	$4,200
H.P. 140 System + 8555A 10MHz→18GHz	$4,000
H.P. 8569B Digital Store 10MHz→22GHz	$15,400
TEK. 7L13 0.1→1800MHz	$2,750



ERICSSON INVERTER/UPS

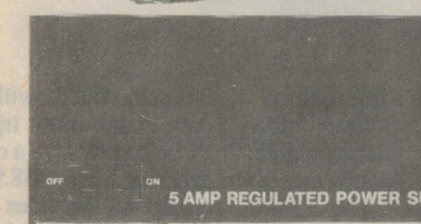
$69.95

- This little beauty has everything
- Currently set up for 48 D.C. operation but will operate on 24V D.C. and probably 12V D.C.
- Comprehensive operation/service manual is included showing modifications
- Output is 240V AC. Reconstructed.

DOW KEY

78 Series Coax Switch
SPDT DC→500MHz
1kW @ 50MHz

Only $20



"ARLEC" D.C. POWER SUPPLY

Output Voltage 13.8v.
Output Current 5 Amps Continuous.
Great for C.B. Amateurs or just a workshop supply.
Very Limited Supply

Used, Clean Tested @

$65

UNBEATABLE PRICES

BARGAIN CORNER!

Pentax Microscope Adaptors (New)	$15
Vacuum Pump with Motor	$165
500ml Measure Cylinders Glass (New)	$12.50
2 BA Thread Taps 3x	Hard to get All 4.50/3
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SPECIAL! US Made Quality Shifters Chrome	
8" Diamond Tool Co.	$9
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IBM Compat P.C. XT 640k + Monitor	$150
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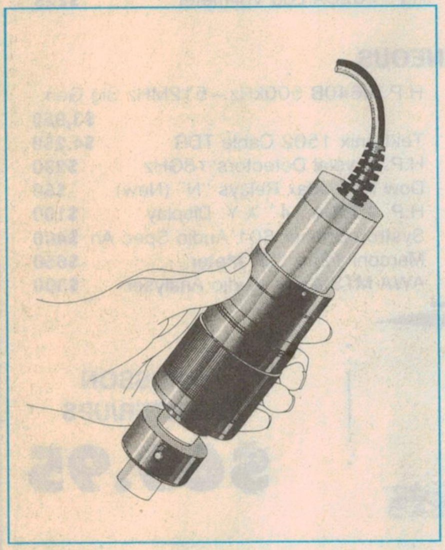
"Kine" Theodolite Camera (Ex Woomera)	$295
Barco 63cm R.G.B. Monitor	$350
Barco 52cm RGB Monitor	$250
Barco 36cm RGB Monitor	$300
G.R. unit Oscillator 50-250 MHz	$65
G.R. unit Oscillator 250-920 MHz	$75
G.R. unit Oscillator 900-2000 MHz	$120

NEW PRODUCTS

Handheld video microscope

Isco Optic of Germany has released the 'InfiniProbe' Video Microscope, a high quality, handheld microscope. This handheld technique is fast becoming standard practice in many industrial, biological, medical and electronic applications (e.g., PCB inspection).



The InfiniProbe is one of seven instruments in the Isco Optic range of macro and micro imaging systems, all of which incorporate a continuously variable internal focusing system.

By turning the focusing ring, you can optically section up and down various layers in the object.

All tubing, photographic and video accessories are common to all systems, making it possible to switch from one system to another, as required.

The unit yields 95x magnification on a 13" video screen. Magnification can be increased with the use of accessories, and the unit can be mounted on a conventional stand. Binocular and trinocular heads can also be fitted.

The most notable advantage of viewing via a video screen is less user fatigue, particularly for people who wear glasses.

For further information circle 242 on the reader service coupon or contact Greater Union Village Technology, 19 Marsden Street, Camperdown 2050; phone (02) 550 5488.

Mobile data terminal

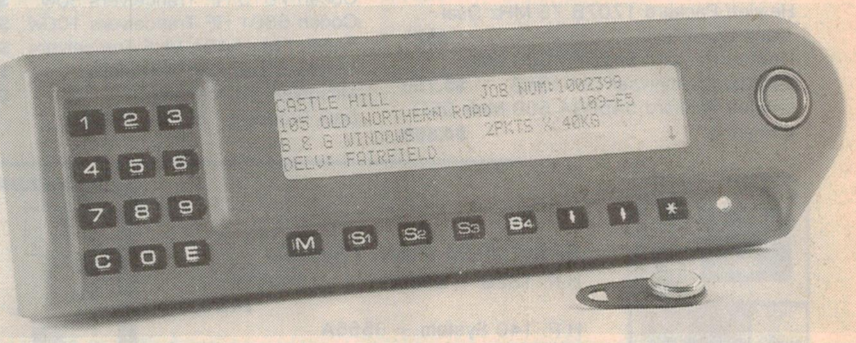
The Expertech Mobile Data Terminal (MDT) is a compact microprocessor-based unit designed for flexible messaging and interaction on a radio communications network.

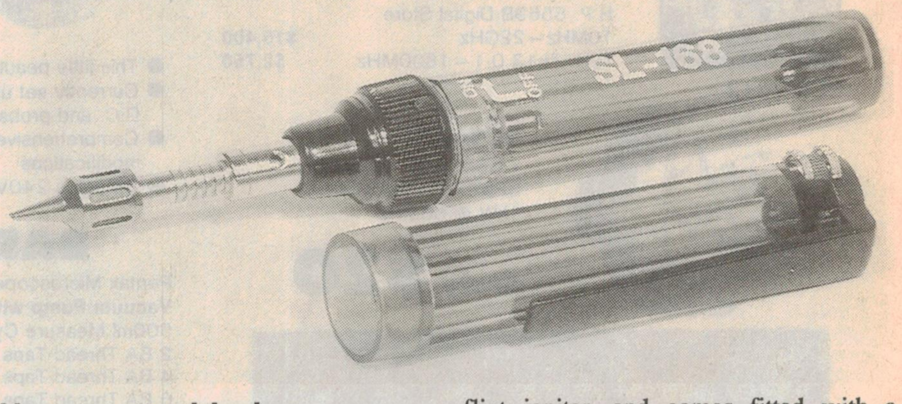
With applications in Courier, Taxi and Service organisations, the MDT-301 is a versatile, reliable and cost effective means of data communications, combining all radio and peripheral interfacing in the one package.

It connects directly to most standard UHF/VHF radios, and provides all the necessary encoding and decoding required for high speed, high reliability data transfer.

In addition, the MDT incorporates a number of features to enhance its value in operation, including a driver identification key-tag reader, two RS232 serial peripheral interfaces with GPS navigation units, vehicle engine management units, barcode readers and so on, and a general purpose set of input status lines.

For further information circle 244 on the reader service coupon or contact Expertech, PO Box 248, North Ryde 2113; phone (02) 880 2157.





New gas soldering tools from Jaycar

Jaycar Electronics has added two new 'Hot-Sol' gas soldering tools to its range: the TS1700 butane iron and the TS1702 service kit — which teams the same iron with a set of tips and other handy accessories.

The TS1700 iron has an adjustable heat control, allowing it to be varied between the equivalents of approximately 10 and 60 watts. It uses standard Butane cigarette lighter fuel, and the transparent tank holds over one hour's supply. The iron has a protective cap with pocket clip and inbuilt flint igniter, and comes fitted with a 2.4mm soldering tip. A hot-blow tip is also available. The iron comes with a one-year warranty and is priced at only $38.95.

The TS1702 service kit provides the TS1702 iron together with torch, hot blow and hot knife tips, non-slip stand with cleaning sponge, a scoop for feeding tubing to the hot-blow tip, a roll of solder and a compact protective case. The kit is priced at $64.95.

Further information is available from Jaycar Electronics outlets, or from Jaycar at 6 Leeds Street, Rhodes 2138; phone (02) 743 5222.

Compact fax

Panasonic has launched a new smart, compact low cost facsimile. Suitable for small businesses, the UF-128M offers features usually found on more expensive machines. For example, this compact unit now carries a 50m roll of paper (usually only 30m on compact models) and has a paper cutter. It can be programmed to hold 70 abbreviated dial numbers, and has a seven page memory for broadcasting, to save users standing around waiting for a transmission to be completed.

Another handy feature is the machine's TAM (telephone answering machine) interface which allows it to automatically receive a voice or fax message if you leave your office. The recommended retail price is $1549. For further information circle 241 on the reader service coupon or contact Panasonic Australia, 1 Garigal Road, Belrose 2085; phone(02) 86 7500. ❖

Special Feature:

Enhancements for personal computers

Tape drive for Centronics port

Overland Data has released the Model 3601 9-track 6250bpi tape drive which interfaces to the host PC via a standard Centronics parallel port.

Since an internal tape drive controller is not required, the overall cost of the data interchange system is reduced considerably.

Features of the drive include an inbuilt carry handle to allow easy transportation from PC to PC, high tape speed of 60ips giving data transfer rates up to 375kbps, low 45W power consumption, simple tape loading and low noise output.

The drive is delivered with the Overland Data interchange and backup software utilities. One full megabyte of cache memory is standard.

The combination of caching and tape speed optimisation ensures maximum data transfer performance and eliminates CPU and disk drive delays.

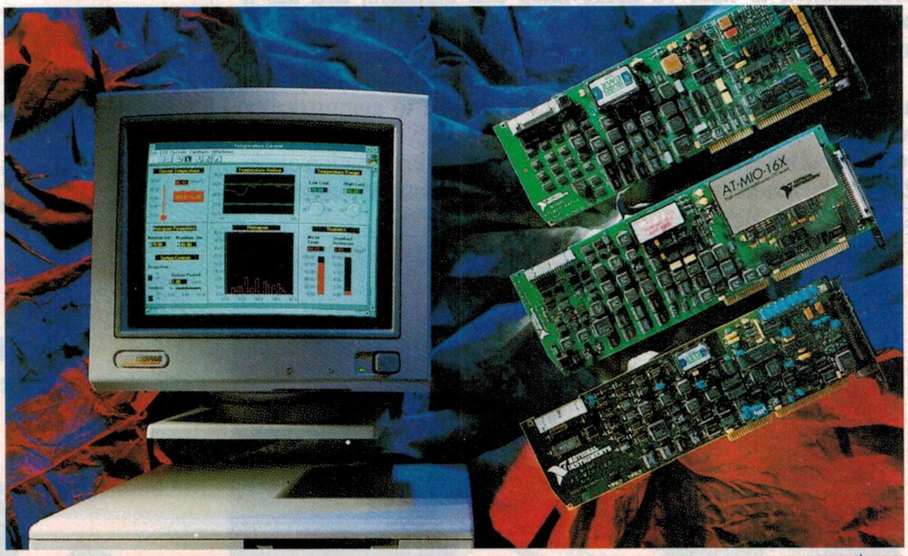
For further information circle 201 on the reader service coupon or contact Elmeasco, PO Box 30, Concord 2137; phone (02) 736 2888.

Data acquisition boards

National Instruments Australia has announced the release of three new high performance, multi function analog, digital and timing I/O data acquisition boards for PC AT and compatible computers.

Engineers and scientists can use these boards to build PC-based data acquisition systems for laboratory automation, process monitoring and control, automotive and aerospace engineering, and electronic test applications.

The AT-MIO-64F-5 has 64 single-ended (or 32 differential) analog input channels with 12-bit resolution; two analog output channels with 12-bit



ADSP card for PC-AT bus

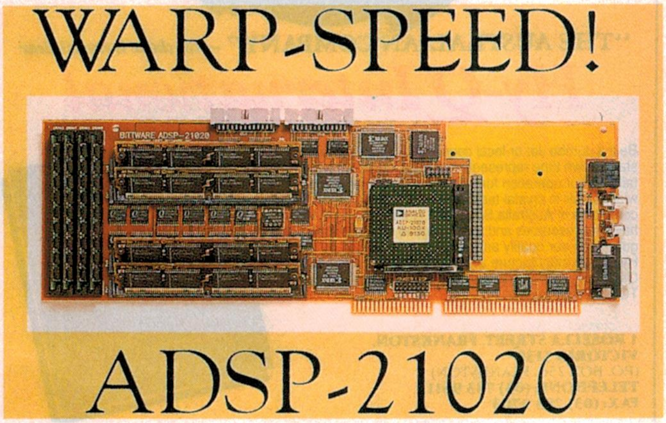
Bittware's Gamma-20/25 card features the Analog Devices' ADSP-21020 floating point DSP processor running at 25MHz, 75MFLOPS peak (50MFLOPS sustained).

Applications for the Gamma 20-25 include image processing and OCR, speech and audio processing, neural networks, and high performance number crunching. The Gamma-20/25 interfaces to the PC-AT bus with high speed transfers to and from DSP data and program memory. Interrupts are also available to and from the host.

The Gamma-20/25 has available program memory SRAM of 32K/128K x 48 bits and zero wait state (768KB max), data memory SRAM of 32K/128K x 40 bits (640KB max) and data memory DRAM of 1M/4M x 32 bits 1 wait state (16MB max). 16 megabytes will store 64 images at 512 x 512 x 8, or will hold over 3 minutes of 44.1kHz 16-bit audio.

Software available includes the Analog Devices 21000 family assembler, C compiler, DSP/C, simulator and debugger and a host interface library with source code in C. The Gamma 20-25 is compatible with the Analog Devices 21020-EZ-ICE software for hardware debugging at assembly and C source levels.

For further information circle 202 on the reader service coupon or contact DSP Solutions, 2 Small Street, Hampton 3188; phone (03) 521 9011.



resolution; eight TTL-compatible digital I/O lines; three 16-bit counter/timer channels; and 16-bit DMA with single and dual DMA channel modes. The board has a 200kHz analog sampling rate and transfers the data directly to memory using DMA.

The AT-MIO-16X has a 16-bit sampling ADC with up to 16 analog inputs that can be configured as single-ended, pseudodifferential, or fully differential inputs. It also has two independent double buffered, multiplying 16-bit DACs, eight lines of TTL-compatible digital I/O, three 16-bit counter/timer channels, 16-bit DMA with single and dual DMA channel modes, and sustained analog sampling rates up to 100kHz.

The AT-MIO-16D has a 12-bit ADC with 16 single-ended or eight differential channels, two double buffered, multiplying, 12-bit DACs, 32 lines of TTL-compatible digital I/O, three 16-bit counter/timer channels, 16-bit DMA with single and dual DMA channel modes, and a 100kHz sampling rate.

Software for the boards includes NI-DAQ, the company's library of data acquisition functions for DOS and Windows applications, and ACQWare, a ready-to-run software system containing analog, digital and counter/timer I/O routines.

Users can simplify scientific and engineering programming with the boards by using two application software packages — LabVIEW for Windows, the newly introduced graphical programming system for PCs, or LabWindows for DOS, a software development system with Microsoft C and QuickBASIC-compatible libraries.

For further information circle 206 on the reader services coupon or contact National Instruments Australia, PO Box 466, Ringwood 3134; phone (03) 879 9422.

Emulator for 3270 terminals

A fully featured, PC-based terminal emulator that provides instant data access to one or more IBM mainframes has been released in Australia.

Reflection 8 bridges the TCP/IP and SNA worlds by providing 3270 communications capabilities to PCs linked to an Ethernet or Token Ring backbone local area network.

It uses the TN3270 protocol, and requires TCP/IP either on the IBM mainframe or on a 3172-style controller attached to the mainframe. This allows a PC to connect simultaneously to as many as many as eight different IBM mainframes which might be located all over the world.

With a new user interface that conforms to IBM's Common User Access (CUA) design specifications, Reflection 8 gives DOS PC's many of the advantages of a windowing platform, including dialog boxes, pull-down menus and buttons, without straining the PC's memory and processing power.

WRQ's Reflection range operates on DOS, Windows and Macintosh computers, providing data access to Hewlett-Packard, Digital and Unix mini and mainframe systems.

For further information circle 204 on the reader service coupon or contact Megatec, 2 Brunswick Road, Mitcham 3132; phone (03) 874 3633. ❖

Silicon Valley NEWSLETTER

Clinton to upgrade Technology Admin

In the first of what could be a large number of high-tech moves, president-elect Bill Clinton said he was considering turning an obscure unit within the US Department of Commerce into a major new high-powered agency that will coordinate efforts to develop and use advanced new technologies in the creation of new jobs.

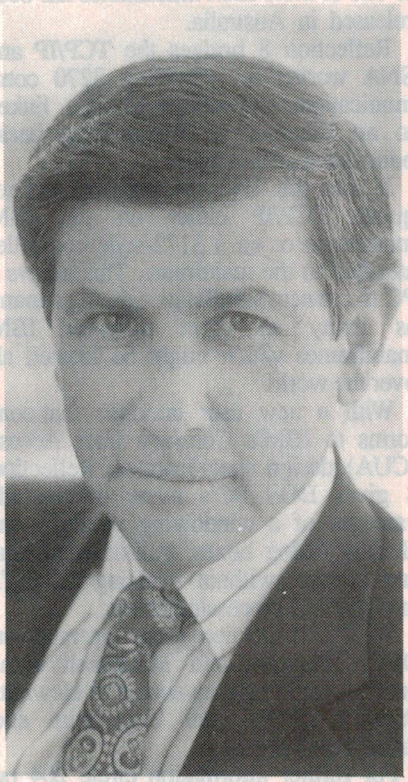
Currently, the Technology Administration department is a three year old unit established in 1989 by Congress, over the objection of President Bush. The group has a 'meagre' US$240 million budget and was given the mission of coordinating technology policies and fostering improved competitiveness in US industry.

Because of Bush's virtual lack of interest in these subjects, the agency's results have fallen far short of expectations. Now Clinton wants to vastly expand the agency's mission and give it broad new responsibilities for refocusing Federal R&D programs on critical technologies and help to push these technologies —which includes aeronautics, high-performance computing, alternative energy, new materials, surface transportation, and environmental clean-up — into the private sector for commercial exploitation.

Currently the task for overseeing the technology policy is divided among 15 - 20 government agencies. The agency's activities would be directed or overseen in some way by vice president Al Gore, who is expected to be appointed as Clinton's 'technology Czar' and take on the task of organising all facets of a new federal industrial technology policy.

Laura Tysan has become the first Silicon Valley high-tech expert to join Clinton's transition team. Tysan is a professor in economics and trade at the University of California at Berkeley, and director of its Institute of International Studies. She will coordinate Clinton's transition team policies on technology and manufacturing.

Tysan will be one of a team of six experts who will be working with Harvard economist Robert Reich (Clinton's top economic advisor) to formulate the new president's economics-related policies.



When IBM and Apple formed a joint venture company last year, many people in the industry predicted that it wouldn't last because of the vastly different corporate cultures of the two partners. However, Taligent's chief executive Joseph Guglielmi (himself a former IBM executive) seems to be making it all work — so far!

Study confirms miscarriage risk

Chip makers around the world are scrambling to react to startling findings in an industry-sponsored study on the health risks to women in the semiconductor workplace.

The study found that women in the industry are 30% less likely to become pregnant, and those who do stand a 40% greater chance of miscarrying than women in other industries.

The US$3.8 million study, conducted by the University of California at Davis on behalf of the Semiconductor Industry Association, tracked more than 15,000 female workers in the industry.

The effect of chemicals used in wafer fabs on women has long been suspected. Several smaller studies, including those by Digital Equipment and IBM, found similar high rates of problems among pregnant workers.

The U.C. Davis study found that a high percentage of women miscarry so early in their pregnancy, that many may not have been aware they even experienced a miscarriage.

The study cited a number of chemicals responsible for increasing the rates of miscarriages and infertility. Particularly hard hit were a family of organic glysol ethers.

"Glysol ethers' days are numbered in the industry," said Craig Modahl of Intel. But neither Intel, the SIA or other individual chip companies has committed to a timetable for phasing out use of the chemicals.

A number of companies, however, have already changed to using ethyl lactate, a derivative of sugar beets. And some companies have implemented programs to allow pregnant workers to transfer to other areas in the company where they would not be exposed to the chemicals.

At the SIA office in Cupertino, officials said the group will look into ways to minimise contact between workers and glysol ethers. The study was welcomed by Ted Smiths and the Silicon Valley Toxics Coalition which he leads. "The effects of glysols have been known for more than a decade. The industry has shown it cares more about the next generation computers than the next generation children. They should ban the chemicals, not the workers."

According to the study, a vast majority of pregnancy problems occurred with women who work in the clean room fabs. While these are virtually dust free, chemicals, including highly toxic arsenic, boron and similar substances float about freely, as evident by the not-so-clean odour that is constantly present in clean rooms.

No Intel microcode for AMD's 486

In a major set-back for Advanced Micro Devices, Federal District Court Judge William Ingram told the Sunnyvale chip maker it has no right to use Intel's microcode in the 486 chip AMD had planned to start marketing in February - March. The decision means AMD will probably not have a 486 on the market until at least mid-year.

The decision follows a verdict by a jury in which AMD was denied the right to use the Intel microcode in a 287 math co-processor. After that decision, AMD asked Ingram to rule whether it was entitled to use the microcode in microprocessors. Ingram ruled it was not.

The two year legal battle goes back to 1976, when Intel and AMD signed a technology sharing agreement in which AMD obtained details of Intel's microcode. Intel asserted that the information was intended for microcomputer development tool kits, not for incorporation into microprocessors and microcontrollers.

In September, after Ingram agreed to consider the question whether the agreement covered microprocessors, AMD said it was going ahead with plans to start marketing its 486 clone chip as early as this month. Now AMD will be forced to delay the launch of that product until it has developed a so-called 'clean room' version of the Intel microcode that will be both fully compatible and different enough in design to withstand any legal assault from Intel.

Intel plans to spend US$2.5 billion

In 1993, Intel is planning to spend an astonishing US$2.5 billion on new plant, equipment and research and development.

The spending spree is staggering when you consider the amount of revenue Intel appears to expect to reap over the next 2 - 4 years, from 486 and 586 microprocessors. The $2.5 billion figure represents a whopping 30% of Intel's expected US$7.5 billion in 1993 revenues. Even by chip industry standards, that is an unprecedented level of investment for a company as large as Intel.

It also comes on top of US$2 billion in investments Intel made last year. By the end of 1993, Intel will have spent US$7 billion in R&D, plant and equipment since the beginning of 1990. And the 1993 budget is larger than the combined capital expenditures of the Santa Clara chip maker in the six years between 1982 and 1987!

By comparison, rival Texas Instruments is currently spending only about US$1 billion a year in new plant, equipment and R&D. Industry analysts said Intel's plans reflect an internal confidence about the company's ability to reap awesome sales from its 486 and Pentium (586) product lines. Already 486 sales are topping the US$1-billion-per-quarter market, three times the level of the 386 at the same point in the product life cycle.

As part of the massive spending plan, Intel will invest US$800 million to upgrade plants in Santa Clara and Hillsboro (Oregon) — to produce 300,000-to-500,000 Pentium chips per week! And US$1-to-15 billion is set aside for 'Fab 11', which will produce next generation products. Another massive US$1 billion factory, 'Fab 10' is nearing completion in Leixlip, Ireland.

Fab equipment shortage looms

A severe shortage of certain types of advanced semiconductor manufacturing equipment could develop by mid-1993, due to a series of aggressive capital investment programs announced in recent months.

While the sudden windfall of orders can easily be absorbed by most of the industry, long lead times may develop for some of the most sophisticated equipment, as the production of some companies was already booked up before the announcement of major capital investment programs by Intel, AMD, and others.

According to Dan Hutcheson, president of VLSI Research in San Jose, which tracks the chip equipment market, companies like Applied Materials and Silicon Valley Group may not be able to handle much additional demand for their products. Already their production is booked up. Increasing production volume is very difficult as the building of highly complex multi-million-dollar machines requires a highly trained technical workforce.

National closes last Valley plant

Silicon Valley without National Semiconductor? While National will remain headquartered in the Valley, the company will no longer manufacture any products there.

The Santa Clara chip maker said it is closing its last major production facility in Silicon Valley, and transferring production of the 5" wafer line to newer 6" and 8" fabs in Arlington, Texas.

After the closure of the last major fab, which opened in 1968, National will only produce R&D level quantities of new chips. The move is part of a US$250 million restructuring program aimed at eliminating under-used chip facilities. Previously, National closed or sold chip facilities in Santa Clara, Salt Lake City (Utah), Puyallup (Washington), Tuscon (Arizona), Hong Kong and Brazil.

China to buy US$2B fab gear from US

The People's Republic of China is determined to improve its semiconductor production capabilities to the submicron level by 1995, and is planning to spend more than US$2 billion in US-made chip equipment to achieve that target — opening a major new market for chip equipment vendors.

The intention to spend such a huge amount over a relatively short period was disclosed to US industry representatives by Chinese government officials during a recent Semicon trade show in Beijing.

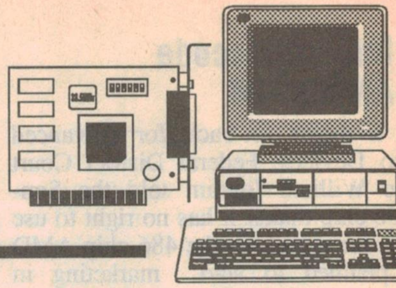
Industry officials said most of the equipment the Chinese are planning to purchase will be allowed to be exported to the PRC following the recent adoption of vastly relaxed export restrictions on semiconductor equipment. The Chinese have also privately told US officials they are focusing almost exclusively on US machinery, in order to avoid becoming dependent on Japan for critical chip-making equipment.

The program could give China a 10% share of the worldwide market for semiconductor equipment, and with nearly all of the equipment coming from the US, would mean an additional huge boost for the resurging US chip equipment industry.

Earlier last year the US regained the role as the world's leading source of semiconductor equipment. Already, its share of the world market has climbed to 53.6%.

China still lags 5 - 10 years behind the US, Japan, and other Western countries in semiconductor technology. But its economy is growing rapidly. Now, China wants to play a major role in future computer and consumer electronics markets — particularly telephones, televisions and other consumer electronics. It wants to develop a components industry that can deliver most of the needed parts, at a fraction of the cost of imported chips. ❖

Computer News and New Products



Dot matrix has LCD control panel

Siemens has given a new lease of life to dot matrix printing with its launch of a range of mid performance matrix printers from Mannesmann Tally, which feature a liquid crystal display (LCD) control panel similar to that found on laser printers. The printers are available in both wide and narrow carriage widths, as well as nine and 24 needle versions. Colour models are also available.

Known as the MT150 series, the printers are easy to set up and use. They have a simple four button control panel with a 32-character LCD. All printer functions, such as whether to print in landscape or portrait, type of paper and other options, can be adjusted using these four buttons. Like that on a laser printer, the LCD gives clear messages regarding status.

Top speed is rated at 370 characters per second and the average workload is 600 pages per day. The nine needle printers are the MT150/9 and MT151/9, with four

resident fonts. The 24 needle printers have eight fonts as standard and are designated the MT150/24 and MT151/24. Industry standard emulations and interfaces are available.

For further information circle 162 on the reader service coupon or contact Siemens Advanced Information Products, 544 Church Street, Richmond 3121; phone 008 032 954.

DADiSP/PRO-32

DSP Development has released its newest version of DADiSP. DADiSP/PRO-32 is the first 32-bit version of the popular general purpose data/signal analysis software for scientists and engineers. The new release delivers up to five times the performance of previous versions on 386 and 486 personal computers.

Using native 32-bit CPU instructions, DADiSP/PRO-32 can address up to 64MB of onboard memory for processing of large datasets often required for technical applications. It adheres to the DOS Protected Mode Interface (DPMI) to operate under Window 3.X, and is compatible with popular VCPI memory managers such as QEMM and 386 MAX.

DADiSP/PRO-32 frees up more of the lower 640K conventional memory to

CD-ROM kit

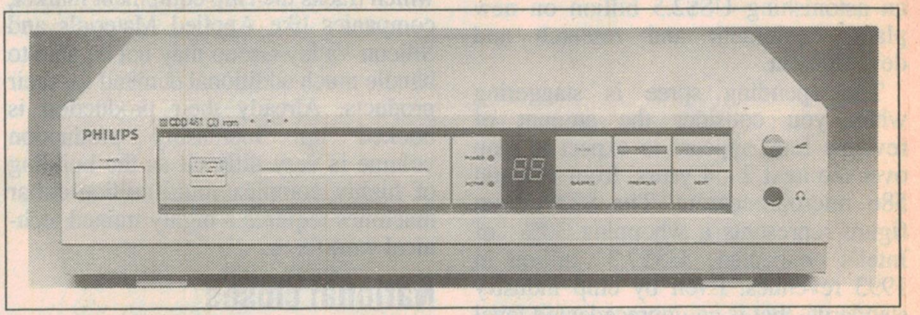
CD-Networks has released a multimedia storage kit that includes not only the CD-ROM drive unit, interface card, cable and software, but a choice of CD-ROM information disks, all for $595 tax paid.

Based on the Philips CDD 461 low cost desktop CD-ROM drive unit, the package allows up to date professionals, or anyone who regularly consults reference information, to experience the real advantages of the efficient, user-friendly CD-ROM.

An additional convenient feature of the CCD 461 is a CD-Digital Audio output, allowing standard audio compact disks to be played, independently of the PC. It has direct front-panel controls and 2-digit track read out and the compact disk sound can be played via the front panel headphone socket or through any stereo system.

The stand-alone desktop drive unit interfaces with 386/486PC or PS/2 computers to provide the facilities needed for fast, easy information access. The storage capacity of a single 12cm disk is the equivalent of 200,000 pages of text or 1500 floppy disks.

For further information circle 161 on the reader service coupon or contact CD-Networks, 26 Crown Street, Woolloomooloo 2011; phone (02) 357 1440.



allow larger, complementary DOS-based programs to run from the DADiSP Pipeline.

Its hardcopy output has been extensively enhanced, adding output at the maximum resolution of the printer, output redirection to a file, improved PostScript and HPGL output, and support for true colour PostScript. In addition DSP has increased the image graphics by a factor of ten. DADiSP/PRO-32 is priced at $2895, with workstation versions starting at $6895.

For further information circle 163 on the reader service coupon or contact Interworld Electronics & Computer Industries, 1G Eskay Road, Oakleigh South 3167; phone (03) 563 7066.

MicroSim enhances Design Center

MicroSim continues to enhance its 'Design Center' simulation package with the release of version 5.3.

New features include an interface to the PADS and Protel board layout packages, HP700 support, device temperature customisation, histograms, multiple plot windows for waveform analysis, hard copy enhancements, tracking/displaying of simulator (PSpice) generated condition messages and editing of model definitions in the schematic capture program (Schematics) to support Monte Carlo analysis.

There are three Design Center configurations from which to choose. The full-featured configuration with schematic capture is available on Microsoft Windows and Sun Open Windows.

Two reduced configurations are available without schematic capture. On DOS (the only platform limited to analog design) and DOS/16M platforms, the package is available with a shell manager that coordinates circuit file editing, P-Spice simulations, graphical waveform analysis, and stimulus generation. The final configuration allows for direct management of the Design Center programs. For further information circle 165 on the reader service coupon or contact Technical Imports Australia, PO Box 1120, Castle Hill 2154; phone (02) 894 6377.

Protel Schematic for Windows

Protel Technology has begun shipping an all new schematic capture system: Protel for Windows Advanced Schematic. (Advanced Schematic joins Protel for Windows Advanced PCB, which has been shipping since December 1991).

The program is fully compatible with Microsoft Windows 3.1, and conforms fully to standard Windows interface conventions for both ease-of-use and consistency with other Windows applications. All Windows display and output devices are fully supported.

A special feature of Advanced Schematic is its support for OrCAD SDT. Advanced Schematic loads OrCAD SDT files directly into the workspace without pre-translation. Files can also be written back out of the system in OrCAD SDT

Bit error tester for ISDN

Wandel & Goltermann has released a new product in its ISDN test equipment range. Besides the basic access ISDN bit error tester IBT-1 and the ISDN cable simulators ILS-1 and ILS-2, there is now also the IBT-2, a bit error tester for the primary rate access.

Based on the same concept as IBT-1, IBT-2 is the perfect instrument for the commissioning of primary accesses before PABX installation. Simulating an ISDN terminal connected to a primary access, the IBT-2 allows the establishment of a communication.

Besides the test of the protocol and of the various ISDN services, IBT-2 allows G.821 qualification of the primary access. All the results, error ratio test, protocol anomalies (levels 1 to 3) can be dumped with the integrated printer.

For further information circle 164 on the reader service coupon or contact Wandel & Goltermann, 42 Clarendon Street, South Melbourne 3205; phone (03) 690 6700.

format with full support for every OrCAD design object. OrCAD STD-compatible libraries and third party utilities are also supported.

Bitmap and vector images can be imported and scaled directly in the schematic sheet using a variety of graphics formats: PCX, BMP, GIF, TIFF, EPS (encapsulated PostScript) and WMF (Windows Metafile clipboard support). Windows TrueType fonts, including bold and italic forms are fully supported.

Standard libraries are organised for convenience, with over 15,000 parts. IEEE and DeMorgan equivalents are provided. An independent library editor provides on-line editing of component attributes. Vector component descriptions are used to provide high resolution display, printing and plotting at all scales. Sixteen user-definable text fields of up to 255 characters are provided for each component description.

For further information circle 168 on the reader service coupon or contact Protel Technology, GPO Box 204, Hobart 7001; phone (002) 73 0100.

PostScript, 1200dpi for HP LaserJet 4

LaserMaster's WinJet 1200 enhancement for the HP LaserJet 4 is designed to work with Windows 3.1, comes with 50 True Type fonts and can print up to 1200dpi resolution.

It also uses Automatic Font Management which gives it access to all True Type and Type 1 fonts on the hard drive. A further advantage is that no extra memory is needed in the printer to run the WinJet 1200 because the upgrade uses the memory in the PC.

The WinJet 1200 offers a choice of three different printer drivers. For drafting purposes, the direct Windows driver gives the quickest Windows printing. Documents that once took a minute or more to print will print in seconds.

Alternatively, there is full Postscript language capability. In this mode, the LaserJet 4's 600dpi output can be increased to produce camera-ready copy at 1200dpi, giving charts, graphs and artwork extra impact.

The third printing option is an HP-PCL4 emulation for printing from Windows or DOS. This is a standard PCL mode.

The WinJet uses the power of the 386 or 486 computer rather than relying on the printer's capabilities. It processes the page data in the PC and then sends it directly to the printer, accelerating the whole printing procedure. Hence, extra computer memory, a faster CPU or a maths coprocessor will all speed up printing as well as applications.

The WinJet 1200 is priced at $1995 (including tax).

For further information circle 171 on the reader service coupon or contact Precision Images, 617 Glenferrie Road, Hawthorn 3122; phone (03) 819 0666.

Ultra 24 Hayes modem

Hayes Microcomputer Products has announced the immediate availability of Hayes V-series ULTRA Smart modem 2400 with Express 96 (ULTRA 24 with Express 96) in Australia, enhancing Hayes' ULTRA product line with a modem that offers more than 10 times the speed of a standard 2400bps modem.

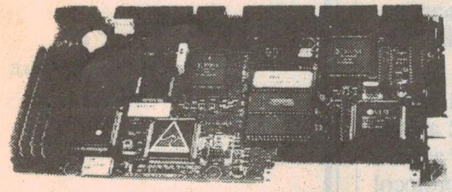
Express 96 is a Hayes advanced proprietary modulation and CCITT V.42 bis data compression which achieves high-speed data throughput to 25kbps. It enables ULTRA 24 to communicate at 4800bps and 9600bps with Hayes V-series ULTRA Smartmodem 14400 and Hayes V-series ULTRA Smartmodem 9600, also available in Australia.

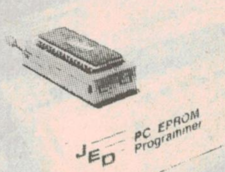
As with all Hayes ULTRA products, ULTRA 24 with Express 96 offers CCITT V.42 error control, as well as CCIT X.32 (Dial X.25) with a four-channel PAD function for dial up access to packet switched networks, the ideal transition for connections between analog modems and digital ISDN systems.

When used with communications software such as Smartcom III that supports Hayes AutoStream, these products allow up to four simultaneous, virtual X.25 connections over one physical link.

ULTRA 24 with Express 96, approved by Austel, is available for a recommended retail price, excluding tax, of $1019.

For further information circle 169 on the reader service coupon or contact Merisel, 4 Sirius Road, Lane Cove 2066; phone (02) 882 8888. ❖





EA DIRECTORY OF SUPPLIERS

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

Supplier	State	A	B	C	D	E	F	G
Altronics	WA	●	●	●	●	●	●	●
Companion Computers	VIC		●					
Dick Smith Electronics	ALL	●	●	●	●	●	●	●
Emona Instruments	NSW						●	
Geoff Wood Electronics	NSW	●	●	●	●	●	●	
Jaycar Electronics	Eastern	●	●	●	●	●	●	●
Kalex	VIC			●				
Macservice	VIC						●	
RCS Radio	NSW			●				
Rod Irving Electronics	VIC	●	●	●	●	●	●	●
Scientific Devices	VIC						●	
TECS	VIC	●	●	●	●	●	●	●
Wagner Electronics	NSW		●		●	●	●	

KEY TO CODING:
A Kits and modules
B Tools
C PC boards and supplies
D Components
E IC chips and semiconductors
F Test and measuring instruments
G Reference books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

Electronics Australia Reader Services

SUBSCRIPTIONS: All subscription enquiries should be directed to: Subscriptions Department, Federal Publishing Co, PO Box 199, Alexandria 2015; phone (02) 353 9944.
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PHOTOSTAT COPIES: When back issues are exhausted, photocopies of articles can be supplied. Price $7.50 per project or $15 where a project spreads over several issues.
PCB PATTERNS: High contrast, actual size transparencies for PCBs and front panels are available. Price is $5 for boards up to 100sq.cm, $10 for larger boards. Please specify negatives or positives.
PROJECT QUERIES: Advice on projects is limited to postal correspondence only and to projects less than five years old. Price $7.50. Please note that we cannot undertake special research or advise on project modifications. **Members of our technical staff are not available to discuss technical problems by telephone.**
OTHER QUERIES: Technical queries outside the scope of 'Replies by Post', or submitted without fee, may be answered in the 'Information Centre' pages at the discretion of the Editor.
PAYMENT: Must be negotiable in Australia and payable to 'Electronics Australia'. Send cheque, money order or credit card number (American Express, Bankcard, Mastercard or Visa card), name and address (see form).
ADDRESS: Send all correspondence to: The Secretary, Electronics Australia, P.O. Box 199, Alexandria, NSW 2015; phone (02) 353 0620.
PLEASE NOTE THAT WE ARE UNABLE TO SUPPLY BACK ISSUES, PHOTOCOPIES OR PCB ARTWORK OVER THE COUNTER.

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Bankcard

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No.of copies required:.....$5.00=..................
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(Unsigned orders cannot be accepted).

ADVERTISING INDEX

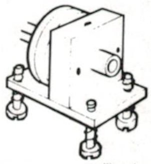
This index is provided as an additional service. The publisher does not assume any liability for errors or omissions.

PASSIVE NIGHT VIEWER

The first generation (XX1080) passive IR night viewer tube features excellent gain, and when used with a very low light objective lens, it can produce useful images under almost as little as sub-moonlight illumination. Cal also be IR assisted. We will supply a XX1080 tube, plus a suitable Lens, plus a kit of parts for an EHT power supply (PCB and components only) for a total price of

$299

IR LASERS



This precision collimator assembly was removed from working laser printers and it is supplied with an extra brand new laser diode to suit. A produces a well collimated laser beam at 780nM 5mW. Barely visible. We also supply a PCB and components kit plus instructions, for a suitable digital driver circuit that can be used to complete the laser transmitter. Suitable for communications, data links, perimeter protection, barcode reading, medical use, etc. **$89** (Item No. 0111)

We can also supply a similar kit which includes a laser diode, unmounted lens, and a driver kit. **$45** (Item No. 0111X)

Note that a suitable receiver for use in perimeter protection is the one published in E.A. April 81.

DIVERGING LENS SPECIAL

A high quality laser beam diverging (beam expander) glass lens, mounted on an aluminium plate, with mounting screws provided. Dimensions: 25 x 25 x 6mm. Use it to expand the laser beam for Holography, Special Effects, or one of the two lenses required to fine focus a laser beam, for Surveying and Bar Code Reading. SPECIAL **$5.00** ea.

LASER GUN SIGHT

A 5mW gunsight at an unbeatable price.

$279

Item No. 0108

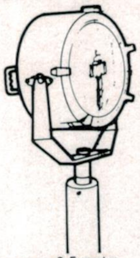
Includes one "Free" rifle or pistol mount.

ARGON LASER HEADS

Used air cooled ARGON laser heads, that produce a BLUE beam! Power output is in the 30-100mW range. Limited stock, at a fraction of their real value: **$600-800**... For the Argon head only. We also provide a circuit for a simple power supply.

Item No. 0109

MARINE SEARCHLIGHTS



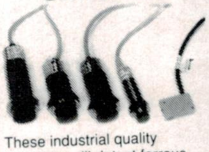
These new 0.5 metre diameter military grade search lights were made by LUCAS in the U.K. They are painted grey and are almost totally made of brass, except for a few stainless steel screws and nuts, a mirrored glass parabolic reflector, and a glass cover plate. They have a detachable mounting pillar which brings the total height of the searchlight and the stand to approximately 2 meters. Fully adjustable positioning and focussing. Supplied with a 1000W/240V quartz halogen lamp (T11): 23,000 lumens. A very impressive unique, product with many applications. Approximate weight of pillar and Spotlight is 60KG.

$1100

(Ref:XXFEB93101)

The $6 P+P charge doesn't apply to this one!! "Ring"

INDUCTIVE PROXIMITY SWITCHES



These industrial quality detectors will detect ferrous and non-ferrous metals at close proximity. Some are DC powered (10-30V0, some are AC powered (Mains), and all will switch loads directly. All have a three wire for connecting into circuitry: Two for the supply, and one for switching the load. LIMITED QUANTITIES at a small fraction of their real price:

$28

VISIBLE LASER DIODE KIT

Brand new 5mW-670nM laser diode, plus a collimating lens, plus driver kit, plus, hardware, plus instructions.

$89

Item No. 0164

VERY LARGE LCD DISPLAY MODULE

Brand new large 640 x 200 dot matrix LCD displays, made by EPSON - SEIKO, screen size is 120 x 265mm, has built in drivers. Four bit TTL interface, a total of 14 connections are required for signal and power (+5V, -12V). Capable of displaying characters, graphs, patterns etc. 28 pages of information included. ON SPECIAL for two months only!

$79

(Item No. 0166)

Note that an LSI surface mount controller IC for this display is available. This IC has a built in character set generator and many other features. It is compatible with 8080 and 6800 MPU's. The IC is available elsewhere for about $35, and we will supply more information upon request.

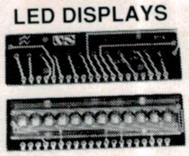
EHT GENERATOR KIT

Based on a brand new, very compact modern EHT flyback transformer which includes an EHT diode rectifier. We supply the transformer, a very simple circuit, and the components to suit. All you need to make a very simple EHT, DC or pulsed AC supply. Powered from 12V DC supply. Great for EHT experiments, EHT testing, plasma displays, etc. Total price for the transformer and the components is ONLY:

$23

Item No. 0161

LED DISPLAYS



NATIONAL SEMICONDUCTOR seven segment, Common cathode, 12 digit, multiplexed, LED display with 12 decimal points. Overall size is 60 x 18mm and a pincut diagram is provided. ONLY **$2.50** ea.or 5 for $10.

12V OPERATED LASER BARGAIN

Two used 3mW Siemens He-Ne visible red laser tubes, and one of our efficient 12V universal laser supply kits.

$109

Item No. 00105X

CRAZY BATTERY OFFER

Brand new industrial grade PANASONIC 12V/6.5AH sealed gel batteries at a reduced price. Yes 6.5 **AMPERE HOURS!** Use them in lighting, alarms, communications, laser power supplies, solar systems etc. Dimensions: 100 x 94 x 65mm. Weight of one battery is 2.2KG! The SPECIAL PRICE? **$38** ea.

(Ref.XXFEB93101)

Furthermore, here is the **CRAZY OFFER.** Buy three of these batteries at the above price, and we will deliver them to any mail addresses in Australia at no additional costs!! **YES $114 TOTAL COST, TO HAVE THREE OF THESE BATTERIES DELIVERED TO YOUR DOOR!!**

We also have available a suitable overnight charger for these batteries (500mA)...$25ea. No additional delivery charge applies if the charger/s is/are bought with the above three battery offer.

LCD DISPLAYS

These are new 16 character by 2 line alphanumeric LCD display modules, with surface mount control circuitry mounted on the rear of the display. Require a few milliamperes at 5V to operate, information included:

$18 ea. or **5** for **$80**

(Item No. 0131)

LIGHT MOTION DETECTOR

Small PCB Assembly based on a ULN2232IC.

This device has a built in light detector, filters, timer, narrow angle lens, and even a siren driver circuit that can drive an external speaker. Will detect humans crossing a narrow corridor at distances up to 3 metres. Much higher ranges are possible if the detector is illuminated by a remote visible or IR light source. Can be used at very low light levels, and even in total darkness. With IR LED. Full information provided. The IC only, is worth $16! OUR PRICE FOR THE ASSEMBLY IS:

$6 EA. OR 5 FOR $25

Item No. 0163

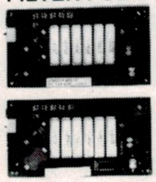
MASTHEAD AMPLIFIER KIT

Based on an IC with 20dB of gain, a bandwidth of 2Ghz and a noise figure of 2,8db this amplifier kit out performs many other IC's, and is a fraction of their cost. The complete kit of parts for the masthead amplifier PCB and components, and the power and signal combiner PCB and components, is priced at an incredible:

$18

Fore more information see a novel, extremely popular, and an effective active antenna design which employs this amplifier: MIRACLE TV ANTENNA - E.A. May 1992.

TUNING FORK FILTER PCB's



Each one of these identical PCB filter assemblies contains six three terminal tuning fork filters (IN-GND-OUT), at different frequencies in the audio range: 1.8-3.1 Khz.

These high quality dual fork filters have very narrow bandwidths, and could be used as the basis of a selective call system, high stability oscillators etc.

PROJECTION LENS

Main body has a diameter of 117mm and is 107mm long. The whole assembly can be easily unscrewed to obtain three very large lenses: two plastic and one glass. The basis of the cheapest large magnifier or projection system? Experimenters delight at ONLY **$28**

D.C. MOTORS

We have good stocks of 5 different high quality JAPANESE DC Motors. These should suit many industrial, hobby, robotics and other applications. Check out the SPECIAL prices, and compare!

M1 - 24V, I No load = 50mA - 22,000 RPM at 24V, main body 28mm Diam - 40mm long...**$5.50**

M4 - 3-15V, I No load = 20mA at 12V, main body 31mm Diam - 22mm long...**$3**

M5-3-15V, I No load = 60mA - 5700 RPM at 12V, main body 28mm Diam - 40mm long...**$2.50**

M9-12V, I No load = 0.52A - 15,800 RPM at 12V, main body 36mm Diam - 67mm long...**$8.50**

M14 - Made for slot cars, 4-8V, I No load = 0.84A at 6V, at max efficiency I = 5.7A - 7500 RPM, main body 30mm Diam - 57mm long...**$9.50**

Further to the above special prices, during Feb.-March we are offering an introductory package which includes ONE OF EACH OF THE ABOVE MOTORS, and one of the STEPPER MOTORS advertised elsewhere in this ad. (Item No. 0140). **SIX DIFFERENT MOTORS FOR A TOTAL COST OF $30.**

ULTRASONIC BURGLAR ALARM KIT

See S.C. May 88 for this high quality crystal locked ultrasonic design. Can be used as a detector or a self standing alarm, has provision for bonnet/boot protection and flashing light and back up battery. Easily combined with our U.H.F. Remote Control. CLEARANCE PRICED AT ONLY:

$29.90

(Cat. No. GK125)

For the P.C.B. and all parts, except the screw terminals. A pair of ultrasonic transducers is included!! DON'T MISS OUT!

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Use them to activate door strikers for entering buildings, car alarms, central locking, the most secure key ever (See E.A. July 92): ON SPECIAL @ **$49.90**

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